Adolescents' reproductive health in rural Bangladesh: the impact of early childhood nutritional anthropometry

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Adolescents’ reproductive health in rural Bangladesh: the impact of early childhood nutritional anthropometry

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To Myrthe and Laurens

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Preface

In the summer of 1983 I went camping with my parents, younger sister and brother. In more than one respect, this summer reflected a transition: not only was I in between two schools (primary and secondary school), but I also reached menarche. Although prepared, it came as a surprise. However, the surprise never turned into fear or shock, as it did with so many of the adolescent girls who we interviewed for this study in Matlab. Also, menarche did not instantly put an end to my ‘period of childhood’ nor did it bring about major behavioural changes such as learning the ‘adult female role’ as described so vividly by Blanchet and White for Bangladesh.

This study is a result of close co-operation between HERA (HEalthy reproduction: Research for Action, a collaboration between the Population Research Centre (PRC) of the University of Groningen and the Netherlands Interdisciplinary Demographic Institute (NIDI), and ICDDR,B (Centre for Health and Population Research, formerly known as the International Centre for Diarrhoeal Disease Research, Bangladesh). The study, carried out between 2000 and 2005, was made feasible thanks to a generous grant from WOTRO (Netherlands Foundation for the Advancement of Tropical Research) and its completion was achieved through financial support from NIDI and HERA, for which I am most grateful.

I was extremely fortunate to have three promoters: Prof. Inge Hutter, Prof. Frans Willekens and Prof. Jeroen van Ginneken. Each of them contributed to this study in a different way and, very important, on a most effective and co-operative basis. This project would never have been conducted if Jeroen, and his wife Lia, had not left in 1996 for Dhaka, Bangladesh, where Jeroen went to work as head of the Health and Demographic Surveillance System (HDSS) at ICDDR,B. I enthusiastically accepted his offer to go to Dhaka for three months to carry out a feasibility study. Was it coincidence or fate that brought you, and subsequently me, to Bangladesh? Jeroen, I highly appreciate your generosity, kindness and continuous involvement in this project. It was Inge, however, who came up with the idea of following up an under-five population to their adolescence and to focus on their reproductive health status. It was also Inge who taught me about the beauty (or in her words, the charm of ‘mud feet’) and the special nature of doing fieldwork. Inge, we went through this project side by side, from A to Z, and although we met with some setbacks, we never lost confidence that this project would ultimately be accomplished. Thank you for this confidence, for sharing your research knowledge and experience, for your enthusiasm and meticulousness readings of the various drafts, and thank you for being so big-hearted. I hope that we will co-operate productive and pleasant in the future as well. I was also most fortunate to have Frans as a promoter because of his statisical expertise and his willingness to help me dredge up and increase my knowledge about lifetable analyses. Frans, I highly appreciate in particular your patience, energy and curiosity.

Heartfelt thanks are also due to Dr. Baqui, affiliated with ICDDR,B and Johns Hopkins University, Baltimore, for providing me the baseline data without which this longitudinal study could not have taken place. In addition, this research could not have been carried out without the conscientiously collected data for the follow-up study. I am foremost very grateful to all adolescents and their parents, most of whom were very co-operative in their response to our questions. With the tireless support of

Mrs. Khaleda Khanam, whom I deeply appreciate for her purposiveness and intelligence, it were Masuda Sharif, Hazera Akter, Zohora Akter, Amina Khatun, Ayesha Begum, Shah Alam, Uttam Kumar Dewanji and Zakir Hossain Khan who made it, together with the porters, an all-out effort to trace and interview the adolescents. *Dhonnobad*!

My appreciation also extends to Mrs. Noor Jahan for her help with data entry and Mr. Bijoy for the translation of Bangla texts. Moreover, I am indebted to numerous other persons from ICDDR,B, especially those from the Health and Demographic Surveillance Programme, the Social and Behavioural Sciences Programme, the Reproductive and Sexual Health programme, all in Dhaka, and those working at the Matlab Field Research Station. It is not possible to mention everyone, but I would like to thank in particular the following: Mr. Chakraborty, Dr. Abbas Bhuiya, Dr. Yunus, Mr. Sarder, Mr. Mobinul Islam, the Emdat family, Dr. Kim Streatfield, Prof. Persson, Mr. Carel van Mels and his wife Jotine, Dr. Japhet Killewo, Prof. Aziz, Dr. Rahman, Dr. Kaniz Gausia, Dr. Dewan Allam, Dr. Shams El Arifeen, Greet Dieltiens, Dr. Lauren Blum, Tazek, Ayesha, Nazneen, Razia, Tamanna, Papreen, Sabrina, Gulshan, Dr. Razzaque, Dr. Nural Alam, Dr. Bairagi, Dr. Golam Mostafa, Mr. Sentu Gomes, Mrs. Lutfun Nahar and Mrs. Nasrin Akhtar. I would also like to convey a special word of thanks to Lutfa Begum, my counterpart for almost two years, and from whom I learned a lot about Bangladesh.

I gratefully acknowledge Prof. Jane Kusin, nutritionist and member of the board of ICDDR,B, for carefully reading drafts of this dissertation. In addition, I thank Dr. Bart de Bruijn and Dr. Frank Eelens from NIDI for their comments on earlier parts of the manuscript. My appreciation also extends to Dr. Albert Mantingh from Groningen University Hospital, Department of obstetrics and gynaecology, for his prompt and effective responses to my questions. I am furthermore grateful to the members of the reading committee (Prof. van Wissen, Prof. Niehof and Prof. White) and would like to thank in particular Mrs. Gina Rozario for correcting the English manuscript.

I am most happy to have been able to conduct this study at NIDI, a highly stimulating and enjoyable environment for research. I would like to thank all NIDI colleagues, and in particular my always supportive roommate Liesbeth, the BMO secretaries Vera and Monique, and all other (former) BMO-ers, i.e. George, Ronald, Bart, Jacqueline, Daniël, Mieke, Jeannette S., Rob, Harry van D. and Ernst. Moreover, I thank Leon for his crash-course in Blaise, which enabled me to complete the entry of survey data within a reasonable amount of time; Jeroen B. for his continuous IT support; Jolande for helping me keep up with the literature; Harry B. for commenting on texts in Dutch; and the 'ladies' of the secretariat, Tonny, Jacqueline and Jeannette van der A. for their involvement and support.

Although I am based at NIDI, the PRC in Groningen feels like a 'home' as well because of the staff and students, as there are or have been: Stiny, Maaike, Sarbani, Karen, Sabu, Mazud, Moury and Mamun, Hideko, Nadja, Ajay, Idske and Miranda and many others whom I have probably forgotten to mention.

In the period between the feasibility study and the completion of this dissertation, I visited Bangladesh several times. Altogether, I spent about 10 months in Dhaka and Matlab, and stayed at many different places and met many different people. I appreciated the comfort of the rooms of the ICDDR,B guesthouse and the Dutch Club as well as that of houses in Matlab (thanks Khaleda *apa* and Shomiron *apa* for your hospitality). Following a more or less chronological order, I thank - again - Jeroen and Lia for hosting me during my very first visit to Dhaka. Warm thanks also to Heidi and Rick. Thanks for your many invitations, the pizzas at the American Club, and just for being there on so many occasions. I am furthermore grateful to Saskia and Karst for sharing their apartment and having me as a lodger for several weeks. I also thank Dineke and Anjali for sharing the 'student house' in Dhaka for another month. The most stressful period that I spent in Dhaka was the three weeks during the flood in the summer of 1998. It was the only time that I saw a boat actually overtake the four-wheel drive that picked me up every morning at the Dutch Club. Also during that period, when the Club was shakened by a bomb alert (a hoax, so we learned later), I was relieved to find another place to stay (thanks Els).

Most of the time that I spent in Dhaka, however, was at the Leprosy Mission Guesthouse. I really enjoyed this stay among an international group of leprosy doctors, missionaries, trainees and consultants. In this respect, I am most grateful to Thomas who always took good care of my belongings whenever I was in Matlab for fieldwork, and with whom I shared most of my 'free' time, alternately at the German Club or the Dutch Club. I am also indebted to Maria, UN GP, and the only woman in Dhaka who dares to bike all the way from Banani to Gulshan. Maria, thanks for your late-night peanut butter sandwiches every time I came back from Matlab later than expected and thanks in particular for taking me in when 'my' room in the guesthouse was rented out to someone else. Allan and Monica, thanks for sharing your 'spiritual food'. During my stay in Bangladesh, I visited mosques and attended ceremonies in several churches and Hindu temples. However, I felt most at ease at your 'after-church dinners'. Finally, various trainees (Nienke, Marleen, Marloes and Nelleke, to name a few) made stays much more pleasant because of shared lunches in the ICDDR,B canteen, dinners and parties.

Words of thanks also to the 'Zonshof groupies' for your support and numerous emails, and whom I have so blatantly neglected in the past year(s). I will better my (post-PhD) life. Lots of appreciation of course as well to my two paranimfs, Annette Kik and Albert Bosch. Finally, I am indebted to my father and mother for their unfailing support throughout my educational and professional career. The choices I have made with respect to education as well as in my professional life are to a large extent driven by some of your mottos among which include 'pursue what makes you happy' and 'if you do your best, you can never really fail'. Finally, I thank Menno. Leaving home for study or fieldwork is bearable only with the prospect of returning to you. I still feel truly blessed to have met you so many years ago (while journeying through adolescence, which says something doesn't it?). Thank you for your love, encouragement, energy, humour and support. A special dimension to this research on reproductive health was added by my own pregnancies during the second half of this PhD study. Khaleda *apa*, you see, I acted on your advice not to forget about my own reproductive life. I hope, in due time, to be able to bring along Myrthe and Laurens to show them the beauty of Matlab and the generosity of its inhabitants. *Inshallah*.

Voorburg, 27 April 2005

1 Introduction

1.1 A lifecourse approach to adolescents' reproductive health in Bangladesh

Monowara[1]*, now a 31-year-old mother, married and moved in with her in-laws at the age of 12 years. Then she had not yet reached menarche, the first menstruation. Menarche occurred one year later, when she was 13 years old. She menstruated three times before she got pregnant. She was still 13 years old at that time. When she was seven months pregnant, her husband died. Her in-laws sent her back to her father's house. Two months later, at the age of 14 years, she delivered her firstborn, a girl. When Monowara was 16 years old, her parents arranged a second marriage for her. She got pregnant after six months of marriage and gave birth to - at the age of 18 years - her second daughter 'Beauty'.*

Adolescents in Bangladesh

Beauty is one of the girls enrolled in our study on adolescents' reproductive health, which was conducted in Matlab, a rural area in Bangladesh. Adolescence is a challenging stage in life, the stepping stone for a child to reach adulthood, and generally defined as the period from 10 to 19 years (UNFPA 1998a, p. 1). The term *adolescence* is also referred to as the period of *puberty*. The biological ethology of both concepts is reflected in the related Latin words *pubertas* (fertile age), *pubescens* (be covered with hair, arrive at puberty) and *adolescere*, meaning growing up to adulthood. In 2000, 24 per cent of the population in Matlab comprised adolescents (ICDDR,B 2002a, p. 22). In Bangladesh on the whole about 25 per cent of the population falls within the adolescent age group (Population Council 2002, p. 1). Due to this large proportion of adolescents - or rather the country's young age structure - it is estimated that Bangladesh's population will amount to 265 million by the year 2050 (ICDDR,B 2002b, p. 75). This constitutes a considerable increase given that the country's population stood at 120 million in 1995 (MWCA 1997, p. 4).

Despite being generally delimited by age, *adolescence* is primarily a social classification based on physical, mental and social markers of development, of which the origins are partly laid in early childhood (embedded within for instance the process of physical maturation and socialisation). The importance of this stage in life has far-reaching implications: adolescence is increasingly seen as the 'gateway to health' because behavioural patterns acquired during this period tend to last throughout adult life (Dehne and Riedner 2001, p. 11). In general, the stage of adolescence includes many, often complex, processes and *rites of passage*, such as the reaching of menarche and spermarche (often indicated by the first self-reported ejaculation of boys as proximity), developing close friendships, dealing with peer pressure, struggling with identity, becoming aware of one's sexuality, developing ideals, and adopting and taking examples from role models. In addition, in Bangladesh adolescence is for girls also a very - perhaps even the most - 'demographically dense' phase in life, as "more demographic actions occur during these years than at any other stage of life" (Islam and Mahmud 1995, p. 22).

[1] Names in this thesis have been altered to protect the identity of the persons concerned. The story of *Monowara* and her daughter *Beauty* has been pieced together from information collected during the fieldwork conducted for this study.

Currently, 48 per cent of the 15 to 19-year-old girls in Bangladesh is married (Population Reference Bureau 2000, p. 21). Historically, mean age at first marriage has been low in Bangladesh: for instance, 12.3 years in 1975 and 14.8 years in 1989 among ever-married women (Islam and Mahmud 1995, p. 23). In Matlab, the mean age at first marriage for girls gradually increased from 16.0 to 18.9 years between 1975 and 1996 (Razzaque et al. 1998, p. 74). Because the low average age of marriage started to increase only three decades ago, the concept of female *adolescence* is considered a "recent development" in Bangladesh (Caldwell et al. 1998, p. 146). Corresponding average ages at marriage for men in Matlab in these years were 24.5 and 26.0 years respectively (Razzaque et al. 1998, p. 74). Births to adolescent girls aged 15 to 19 years make up 18 per cent of the *total fertility rate* (TFR) in Bangladesh. The TFR in this country is 3.3 (Population Reference Bureau 2000, p. 21). In 1993-1994, no less than 21 per cent of the adolescent births in this country were unplanned (TAGI 1998, p. 52-53). The proportion of girls in Bangladesh who have given birth by the age of 20 years is 63 per cent (Population Reference Bureau 2000, p. 21). Less recent data show that 20 to 24-year-old women in Bangladesh who had a child by the age of 15 and 18 accounted for respectively 11 per cent and 47 per cent in 1993-1994 (Singh 1998, p. 121).

Education seems to be a factor of singular importance in this respect: in Bangladesh the proportion of 20 to 24-year-old women having a child before the age of 18 was 54 per cent in 1993-1994 among those with less than seven years of schooling and 19 per cent among those with seven or more years of schooling (TAGI 1998, pp. 52-53). A similar pattern is found in Matlab (Shaikh 1997). In addition, employment may delay early marriage and childbearing, as illustrated by research among adolescent garment factory workers (Amin et al. 1998, pp. 185-200). Pregnancy and childbirth are leading causes of death among adolescent girls in developing countries. In Bangladesh the risk of maternal mortality may be five times higher for mothers aged 10 to 14 as compared to mothers aged 20 to 24 years (Mayor 2004, p. 1152). Often risks are further elevated because pregnant adolescent girls are less likely to undergo antenatal and obstetric care (WHO 2003, p. 36).

ICPD and the early life paradigm

Manifold appeals advocating adolescents' well-being (for instance IPPF 1994; Kabir 1997; UNFPA 1997; UNFPA 1998a; UNFPA 1998b; UNFPA 1999; Dutch Ministry of Foreign Affairs 1999; UNFPA 2000; ICRW 2002; UNFPA 2003) and two major paradigm changes have laid the foundations for this dissertation. The first paradigm change relates to the shift in focus within the population and development framework, as became manifest at the International Conference on Population and Development (ICPD) in Cairo in 1994. Apart from the dearly won agreement on reproductive health per se and the acknowledgement of reproductive health as a *human right*, at the ICPD the importance of *adolescence* to sexual and reproductive health throughout the lifecourse was stressed. Moreover, it also - for the first time in an international agreement - recognised that adolescents have particular health needs that differ in important ways from those of adults (UNFPA 2003, p. 4).

The second change refers to the shift from the 'life style paradigm' to the 'early life experience paradigm', of which studies conducted by Barker and his colleagues probably are the most salient exponents (Barker 1992; 1993; 1998; Eriksson et al.

1999; Barker et al. 2001). Central to the 'foetal origins of disease hypothesis' (also referred to as the 'Barker hypothesis') is the concept of metabolic *programming*, meaning that an early stimulus or insult, operating at a *critical or sensitive period*, results in a long-term change in the structure or function of the organism (Robinson 1992, p. 2). It has been suggested that metabolic and cardiovascular changes are adaptations for foetal survival in an inadequate nutritional (in utero) environment, and that these changes persist postnatally, contributing to adult chronic diseases when nutrients are plentiful (Pojda and Kelley 2000, p. 7). The hypothetical set of adaptations occurring in utero resulting in babies with a low weight at birth and a specialised metabolic and cardiovascular make-up, is also referred to as the 'thrifty phenotype' (Bateson 2001, p. 930). The shift to the early life experience paradigm reinforced the need for further application of *lifecourse* research. The lifecourse can be seen as the period from conception to death that encompasses the totality of experiences of life at a given time in history (Berger 1996, p. 167).

Aim of the study

In this study the two aforementioned paradigm changes are examined simultaneously. We aim to study the *reproductive health status* of 12 to 16-year-old *adolescents* in Matlab, Bangladesh, in relation to *contemporary* and *early childhood* (i.e. up to the age of five years) *nutritional status*. In this study nutritional status is assessed on the basis of international standards of *anthropometric* indices (combinations of measurements) such as *weight-for-age* (undernutrition), *height-for-age* (stunting), *mid-upper arm circumference* (MUAC) and *body mass index* (BMI) that indicates thinness and which is also referred to as the Quetelet Index (WHO 1995). In addition, age at menarche and the nutritional status of the adolescent's mother is taken into account.

Indicators of adolescents' reproductive health

Reaffirming the vision agreed upon in the Alma Ata Declaration in 1978, at the ICPD reproductive health was defined to encompass "a state of complete *physical*, *mental* and *social* well-being (…) in all matters relating to the reproductive system and to its functions and processes" (ICPD 1994 paragraph 7.2, p. 45). The Programme of Action (PoA) as adopted at the ICPD refers to a variety of topics associated with adolescents' reproductive health, such as unwanted pregnancy, unsafe abortion, sexually transmitted diseases (STDs), including HIV/AIDS, the prevention of early marriage and high-risk childbearing (ICPD 1994; UNFPA 1999; FCI 1999). However, no *specific indicators* of adolescents' reproductive health were defined.

In order to arrive at an indicator of *physical* reproductive well-being in adolescence, a reference could be made to the 'Gold Standard' of adolescent maturity: the method developed by Tanner in 1962 and still in use, which is based on stages of breast development, testicular size and pubic hair (Soekarjo 2003, p. 19). For obvious reasons this method is not suitable for fieldwork studies (WHO 1995, p. 267). However, in a study undertaken in rural Indonesia, self-reported age at menarche and (first) nocturnal ejaculation (spermarche[2]) showed to be valid, as well as culturally

[2] Spermarche is the first release of spermatozoa, which can be detected in urine samples (Hirsch et al. 1979, pp. 289-298). In general, measuring spermarche is an expensive procedure for which highly specialised equipment and facilities are needed, as well as very specialised training and skilled personnel, and requires multiple observations or long-term longitudinal data (WHO 1995, p. 267).

acceptable and appropriate milestones for adolescent maturity rating (Soekarjo et al. 2003, pp. 27-39). We will study the *timing* of these reproductive transitions (menarche and spermarche respectively) among adolescent girls and boys in Matlab, Bangladesh.

With respect to mental reproductive well-being in adolescence, a link can be made to what is called 'developmental readiness', which is key in Erikson's theory on psychosocial development which he consolidated from 1950 onwards (Erikson 1963; Sugarman 1986, p. 83; Erikson 1997). In his view people develop in stages whereby progress through each stage is in part determined by success or lack of success with acquiring certain developmental tasks in previous stages. In this study we analyse knowledge and perceptions (including emotions) about reproductive transitions and developmental processes that are typical of the adolescent stage. If one is 'prepared', the reaching of menarche or spermarche is less likely to be experienced in ignorance or anxiety. Moreover, 'reproductive knowledge' (or 'knowledge about reproductive health') is required in order to be 'prepared' (or ready) for future reproductive health events (notably childbirth) and for maintaining reproductive health status in adulthood. In this study adolescents' reproductive knowledge is reviewed on the basis of generally accepted bodies of knowledge about for instance the origins of menarche, human procreation and the working of contraceptive methods. Having an understanding is a prerequisite of (contemporary and future) informed choice, a concept closely associated with other so-called 'ICPD glossary' such as reproductive rights, dignity, empowerment, self-determination and responsibility. In sum, following the ICPD PoA, adolescents' reproductive health status is considered to comprise a *physical* and *mental* component, whereby the outcome indicators are respectively:

- timing[3] of menarche and spermarche (physical component); and
- reproductive knowledge and perceptions (mental component).

Beauty was 13 years old when we interviewed her. She had not reached menarche yet. Contrary to most of her peers, Beauty has been prepared for mashik[4] *or menstruation. She was informed by her sister - not by her mother, because her mother does not talk to her about such things. Beauty knows it can happen any time now, probably before her next birthday. Or later. Among Beauty's 15 and 16-year-old peers respectively 41 and 19 per cent are still premenarcheal (as revealed in this study). Beauty does not remember ever experiencing hunger in her childhood. However, as an under-five child, Beauty was severely underweight (i.e. having a low weight-for-age) and moderately stunted (i.e. having a low height-for-age). Now, in adolescence, she weighs almost 30 kg and is 138 cm tall, i.e. still moderately underweight and moderately stunted. She does not differ in this respect from her peers. It will take some time before she approaches her mother's height of 150 cm.*

However, data on spermarche are usually collected by retrospective recall, as in the study of Soekarjo et al. (2003).

3 Given the focus of our study, we explicitly refer to 'timing of menarche and spermarche', though this may seem redundant since these transitions, expressed by age, already include an indication of time. In order to avoid confusion in this study we apply the term 'age at menarche' instead of 'menarcheal age' as the latter is sometimes interchanged with 'gynaecological age' which is defined as the time since menarche (Becker 1993, p. 33).

4 Bangla words and concepts are explained in the glossary (Appendix A).

Lifecourse approach and careers

As noted, we adopt a *lifecourse* approach to the study on adolescents' reproductive health whereby we study particularly the anthropometric determinants of menarche. Within the lifecourse, intertwining and partly running parallel *careers* can be distinguished (de Bruijn 1999, p. 186). The *reproductive health career* is closely related to the *nutritional status career*. For instance, in general, girls who are *severely* stunted face a risk in their reproductive health as stunting delays the first menstruation, may jeopardise the course and outcome of pregnancy, and is likely to increase the risk of obstructive labour (Riley 1994, pp. 90-91; WHO 2003, p. 13). These detrimental outcomes may be reinforced by the adolescent girl's underweight due to recent malnutrition. However, adolescent nutritional anthropometry, notably stunting, is an outcome of a series of *early life* nutritional anthropometry and merits study in its own right.

Pathways: programming and cumulative causation

We study menarche (and to a lesser extent spermarche since there is much less data and evidence-based literature about this topic) *retrospectively*, i.e. in relation to contemporary and early childhood nutritional status. Nutritional status is widely recognised as one of the most important non-genetic determinants of menarche (Riley et al. 1993, p. 50). In the early 1970s, timing of menarche was believed to be 'triggered' by a certain critical weight (Frisch and Revelle 1969; 1971), but the evidence for this relationship was weak (Trussell 1980). In later studies, other anthropometric indices such as adolescent height, MUAC and BMI were (also) positively associated with menarche (for instance, Delgado et al. 1985; Linhares et al. 1986; Maclure et al. 1991; Koprowski et al. 1999). More recently, there is growing support for the possibility that timing of menarche may be set *in utero* or early in life but may be modified by changes in body size and composition in childhood (Silva et al. 2003, pp. 405-412), a line of thinking which relates to the aforementioned Barker hypothesis.

Among the population of Bangladesh malnutrition has been prevalent for generations as a result of which individuals are both prenatally as well as postnatally exposed to nutritional micro and macro deficiencies. In addition, in Bangladesh there is a well-documented list of factors (notably infectious diseases, diarrhoea, adverse environmental conditions and behaviours) which contribute to the *'chain of risks'* impacting nutritional anthropometry in the negative. This chain of risks is an alternative pathway - that of *cumulative causation* - which describes how experiences in early life increase the likelihood of future events which in turn lead to a change in the risk of adult diseases and which can be advantageous or detrimental in their effect (Kuh and Ben-Shlomo 1997, p. 7).

Sensitive or critical periods

Within the Bangladeshi population stunting seems to have become an embodied[5] trait. The overall picture in Bangladesh is one of widespread malnutrition, particularly

[5] Embodiment describes how extrinsic factors experienced at different life stages are inscribed into an individual's body functions or structures. This may be through a developmental process associated with critical periods (Kuh et al. 2003, p. 5).

among women and children. In rural Bangladesh, 57 per cent of the women are less than 147 centimetres tall as a result of stunting, virtually all mothers weigh less than 50 kg (Ross et al. 1996, p. 10), and 47 per cent has a BMI below 18, indicating underweight (WHO 2003, p. 8). Over 60 per cent of the under-fives in this country suffers from malnutrition (ICDDR,B 2002b, p. 36). More specifically, 58 per cent of the under-fives in Bangladesh (1993-1995) is underweight, 55 per cent is stunted, 73 per cent is anaemic and 78 per cent has vitamin A deficiency (WHO 2003, p. 8). In addition, Bangladesh has the highest rate (50 per cent) of children born full-term with low birth weight (LBW), defined as a weight at birth below 2500 grams, as a result of intrauterine growth retardation (Pojda and Kelley 2000, pp. 3-4). Such a high prevalence of LBW is an *intergenerational* problem (Pojda and Kelley 2000, p. 2).

Gestation and early childhood are *sensitive* or *critical* for the adolescent stage in life. A delay in early life growth can hardly be stopped or reversed and after the age of two years the potential for catch-up growth[6] is indeed limited when such children remain in poor environments (Gillespie and Flores 2000, p. 2). If environmental conditions improve, particularly in terms of favourable nutrient intake, the period of adolescence could be *a window of opportunity* to catch up early life growth faltering (WHO 2003, p. 10), although evidence of complete catch-up in developing countries is limited (WHO 2003, p. 22). In one of the few studies on this, undertaken in Guatemala, catch-up growth was reported to take place in adolescents, but they did not fully negate the growth retardation of early childhood (Martorell et al. 1995). Also within developmental psychology such special time windows have been identified. Reviewing multi-dimensional development processes, Jenniskens and Verduin (1998, p. 17) outline four points in life at which it is not possible to catch up on deficits (also called 'points of no return', i.e. interventions cannot make up the deficit), respectively at birth, at 12 months (brain development), at 3 years (height and mental development) and adolescence (behaviour).

Justification of a study on menarche

The justification of a study on timing of menarche relates mainly to future transitions embedded within the reproductive career. A key aspect is *gynaecological age*, i.e. the time in years since menarche (Becker 1993, p. 33). Irrespective of age, at the time of reaching menarche girls have approximately 4 per cent more height and 12 to 18 per cent more pelvic growth ahead of them, and height and pelvic size are correlated (WHO 1991, p. 6). A stature below 145 cm and a weight below 45 kg are considered as cut-off points for obstetric risks (WHO 2003, p. 22). We therefore argue that *young gynaecological age* (as a result of delayed menarche) at the time of childbearing in conjunction with malnutrition (reflected by a *biological age* lagging behind *chronological age,* i.e. age measured in calendar years) is more important to reproductive health than young chronological age.

Context

Though the indicators of adolescents' reproductive health as well as contemporary and early life determinants are situated at the micro level (i.e. they are individual traits), they are influenced by (higher-level) contextual factors. For instance, *socio-cultural* family and societal norms influence intra-household distribution of food and

[6] Catch-up growth is defined as the recovering of a delay in growth (Silventoinen 2000, p. 22).

impute early marriage and childbirth. These higher-level contextual conditions and circumstances shape the adolescent's 'career of reproductive knowledge and perceptions', or generate a socio-cultural climate which places reproductive information or services within or beyond the reach of adolescents. It is within the process of socialisation during childhood and adolescence that gender roles are internalised and perpetuated. Particularly in adolescence, it becomes apparent that societal expectations in Bangladesh, a country where 88 per cent of the population is Muslim, differ considerably for boys and girls (Aziz and Maloney 1985; Blanchet 1996; Amin et al. 1997). This should also be viewed within the overall *socio-economic* context of Bangladesh. In 1996, the FAO identified Bangladesh as a 'low-income food-deficit' country i.e. a country that has not enough food to feed its population and lacks the financial recourses to pay for imports (USAID 1997, pp. 8-9). Poor living conditions directly influence the adolescents' nutritional status, educational and professional opportunities.

Beauty does not have a boyfriend. In due time, her parents will arrange a marriage for her. As far as she knows they have not done that yet. However, in contrast to her future husband she may very well only be informed about her marriage at the final stage of the negotiations, possibly even on the wedding day itself. And much will depend upon her dowry[7]*. If it was up to Beauty, she will marry when she is 20 years and become a mother two years later. She is familiar with possible health problems - notably difficult labour and childbirth - when a girl gets pregnant at an early age. She wants to have three children later, at least one son and one daughter. In order to accomplish that, she needs to learn about sexuality and family planning. She has heard about the pill, but does not know how it works. She would like to be informed by a health worker. Neither her mother, Monowara, nor her father, has completed a single year of education. Beauty, however, enjoys going to school very much and has completed four years. She aims to finish secondary school as well. After that, she will stay in Matlab and become a health worker. And a wife and mother, naturally.*

1.2 Embedment of the study

Bangladesh has officially adopted the ICPD definition of reproductive health. Reproductive health services, policies and programmes aimed at adolescents, as well as on the improvement of maternal and infant nutrition, are either in effect or underway (Hardee et al. 1998, p. 6). Inspired by the ICPD PoA, the government of Bangladesh submitted the Health and Population Sector Strategy (HPSS) in 1997, on which it also based its 1997-2002 Fifth Year Plan. However, the planned reproductive health services for adolescents pertain to *married* adolescents only (Hardee et al. 1998, p. 65). Unmarried adolescents remain a marginalised group. In this study we have identified some of the reproductive health needs as prevalent in the *early* stage of adolescence of *unmarried* adolescents in particular.

In addition, this study focuses explicitly on adolescent girls *and* boys. For a long time most reproductive health studies tended to focus on (married) women only, particularly in Bangladesh. Recently, policy makers and researchers emphasise however the need to incorporate the 'male' perspective into research and action programs. As stipulated by UNFPA (1997, p. 9) "in adolescent programming, it

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[7] Transfer of money or valuables from the family of the bride to the groom and his family (Amin and Cain 1997, p. 296).

should be natural to stress the equal and individual responsibility for safe and healthy sexual behaviour, the need for the man to respect the reproductive choices of the woman, and the shared responsibility in case of pregnancy and childbirth".

Our study is the result of collaboration between HERA (HEalthy reproduction: Research for Action, a co-operation between the Population Research Centre of the University of Groningen and the Netherlands Interdisciplinary Demographic Institute) and ICDDR,B (Centre for Health and Population Research, formerly known as the International Centre for Diarrhoeal Disease Research, Bangladesh). ICDDR,B is a well-known institute with years of experience in reproductive health research and adopts a very similar approach to reproductive health as the one adopted by HERA: both are engaged in translating research results into action. Examples of successful projects engaging community participation that respect and use existing social structures (by community organisations) are for instance *Spandana* in rural India run by HERA in co-operation with local researchers and a local NGO (Hutter 1998), and the *Chakaria* Community Health project by ICDDR,B in rural Bangladesh (Eppler et al. 1996).

For nearly four decades ICDDR,B has been carrying out research in Matlab, an area that is known for its rich research history, reflected in the elaborate collection of data. Virtually all inhabitants of Matlab are enrolled in a Health and Demographic Surveillance System (HDSS), maintained by ICDDR,B. The basis of HDSS is a so-called Registration IDentification (RID) number. In 1997, a three-month feasibility study was conducted in Matlab (Bosch and Hutter 1998), which led to the development of a research proposal for this study.

1.3 Research questions

This study is designed to examine adolescent's reproductive health from the lifecourse perspective and it is grounded on the following overall research question:

What is the reproductive health status of adolescent girls and boys in Matlab, Bangladesh, and to what extent is this status associated with contemporary and early childhood nutritional anthropometry?

We aim to answer this overall question by addressing five specific research questions that account for physical and mental well-being of adolescents' reproductive health:

Questions pertaining to physical well-being of adolescents' reproductive health

1. What is the reproductive health status of adolescent girls and boys as indicated by the timing of menarche and spermarche respectively?

2. What is the contemporary nutritional status, as indicated by anthropometry, of adolescent girls and boys, and does this differ by sex?

3. Is nutritional anthropometry in adolescence predisposed by nutritional anthropometry in early childhood, birth weight, and height of the adolescent's mother? And, related to this, is there any potential to catch up early childhood growth faltering in adolescence?

4. Is timing of menarche predisposed by contemporary and early childhood nutritional anthropometry, birth weight, as well as height and age at menarche of the adolescent girl's mother?

Question pertaining to mental well-being of adolescents' reproductive health

5. Are adolescent girls and boys informed about and prepared for menarche and spermarche respectively, and reproductive development in general?

By subsequently answering each of the five research questions, the study endeavours to disentangle the multitude of factors constituting adolescents' reproductive health status and to assess the relative contribution of some of its main contemporary and early childhood determinants.

1.4 Study population and longitudinal data collected in two surveys

Studying adolescents' reproductive health from a lifecourse perspective requires analyses of longitudinal data. Our study involves the follow-up of 707 under-five children who were enrolled in a study on persistent diarrhoea conducted in Matlab in 1988-1989 by Baqui, a paediatrician affiliated with ICDDR,B (Baqui 1990; Baqui et al. 1992; 1993a; 1993b; Zaman et al. 1996; 1997). His study served as a baseline for a follow-up survey, which we undertook in 2001. By that year the under-fives had grown up to adolescents, aged 12 to 16 years, and the majority of them (569) was surveyed again. In order to learn more about perceptions about reproductive health, additional information was collected among 18 adolescents, 8 parents and 3 local key-persons by means of in-depth interviews. We also analysed the HDSS records of those children who were lost for follow-up due to death or migration.

The analyses of the data involves descriptive statistics and binary logistic regression techniques (odds ratios) of the sample (observed) data; calculation of estimates (of age of menarche) by means of lifetable (survival) analysis and the Cox regression model; and reviews of the 'voices of the adolescents' (based on the in-depth interviews).

1.5 Scientific and social relevance of the study

The opportunity to follow up a group of under-fives 13 years later made it possible to study adolescents' reproductive health in view of context as well as lifecourse. To our knowledge, there have been only few of such longitudinal studies conducted in developing countries, for instance in Guatemala (Martorell and Scrimshaw 1995; Stein et al. 2003), in Gambia (Ceesay et al. 1997; Moore et al. 2001), and in Indonesia (Kusin and Kardjati 1994; Alisjabana and Kusin 2003).

The specific features of this study are as follows:

- a study population consisting of unmarried adolescent boys and girls in rural Bangladesh;

- a focus on their reproductive health status, a ‘sensitive’ topic studied among a 12 to 16-year-old population which has for long been neglected in (reproductive health) research undertaken in this country;
- a focus on reproductive health status from two different angles, i.e. consideration of a physical component (indicated by timing of menarche and spermarche) and a mental component (indicated by reproductive knowledge and perceptions);
- the application of a lifecourse perspective, which is one of the angles that can be taken within the process-context approach. Applying this approach to adolescents’ reproductive health is rather new within the discipline of demography;
- crediting the important role of contemporary and early childhood nutritional anthropometry in reproductive health, which enhances the increasing interdisciplinary character of demographic research;
- conducting analyses based on longitudinal data, consisting of quantitative (survey) as well as qualitative (in-depth interviews) data, whereby
- the quantitative database consists of linked data, i.e. secondary or baseline data and primary or follow-up data.

1.6 Organisation of the book

Chapter 2 presents a descriptive and explanatory framework of adolescents’ reproductive health viewed from the lifecourse perspective, with special reference to the mediating role of nutritional anthropometry from birth onwards. We particularly focus on the timing of menarche, both from a physical as well as social perspective. Moreover, we address the meaning of adolescence in (rural) Bangladesh from a gender perspective.

Chapter 3 discusses the research design, including the hypotheses, the operationalisation of the main variables, required data and methods of data collection. The last named includes a thorough description of the experiences encountered while undertaking the fieldwork among the adolescents in Matlab.

Chapter 4 introduces a brief demographic and socio-economic profile of the study population, both in childhood as well as in adolescence. In addition, we elaborate the characteristics of the children who were lost for follow-up because they passed away or migrated out of Matlab before the onset of the follow-up survey in 2001.

Chapter 5 is devoted to the nutritional status career. We discuss nutritional anthropometry in adolescence in relation to nutritional anthropometry in early childhood, at birth and height of the respondent’s mother. Central to this chapter is the question of the extent to which adolescent nutritional anthropometry is predisposed by nutritional conditions earlier in life. While answering this question we also address the potential of girls and boys in adolescence to catch up early childhood growth faltering.

Chapter 6 discusses results of analyses on the timing of menarche and spermarche (the physical component of reproductive health), which marks the onset of the reproductive health career. Timing of menarche is discussed in terms of age, and by comparing age at menarche between mothers and daughters. In particular the nutritional pathways underlying the timing of menarche are studied in view of contemporary (adolescent) and early childhood nutritional anthropometry.

Chapter 7 discusses the adolescents' knowledge and perceptions (the mental component of reproductive health) about reaching reproductive transitions, menstruation, markers of adolescent development, procreation, early marriage and childbearing, contraception and HIV/AIDS prevention.

Finally, Chapter 8 summarises the main findings of the study and discusses its conclusions. Additionally, we propose some recommendations for further research and interventions in the field of reproductive health of adolescents and young women in Bangladesh.

2 Theoretical framework: adolescents' reproductive health in the context of early childhood nutritional anthropometry and socialisation

2.1 Introduction

The aim of this chapter is to introduce a theoretical framework on adolescents' reproductive health in the context of contemporary and early childhood nutritional anthropometry and gender-specific socialisation. Studying adolescents' reproductive health status by taking explicitly into account early life conditions necessitates the application of a *lifecourse* approach. Indicators of adolescents' reproductive health status that we consider are:

- timing of reproductive *transitions* (menarche and spermarche), and
- reproductive knowledge and perceptions.

As we will elaborate in this chapter, the underlying mechanisms determining this status refer to:

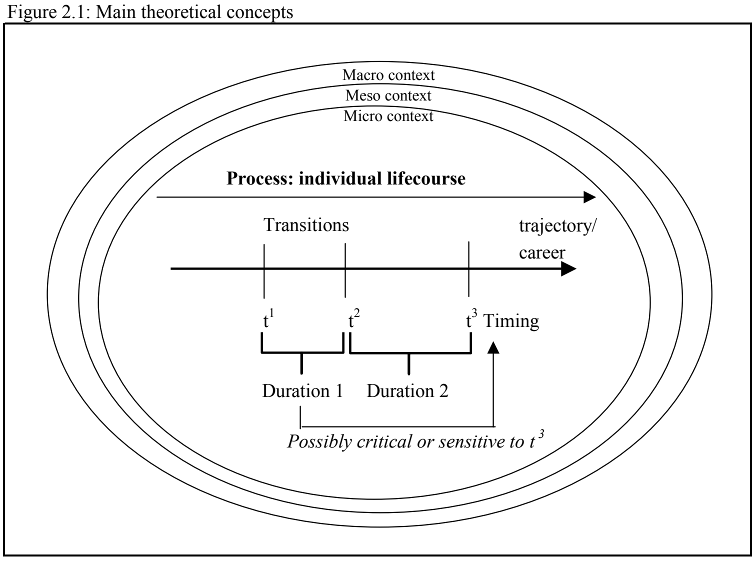
- *processes* or changes over time (nutritional status development, socialisation);
- whereby determinants are embedded within nested multi-level (micro, meso and macro) *contexts.*

The outline of this chapter is as follows. We first elaborate upon the key concepts of the theoretical framework (section 2.2), after which the nutritional status career, with particular reference to the adolescent period, is discussed (section 2.3). We then sketch the start of the reproductive career whereby we elaborate upon the concept of adolescents' reproductive health within the context of Bangladesh, and subsequently address the *physical* pathways underlying timing of menarche and spermarche as well as the *social* significance of these transitions (section 2.4). Although the temporal scope of this study does not exceed the period of adolescence, thereafter some reproductive events are addressed that reflect the first steps into adulthood - marriage and childbirth - and which are in part directly related to nutritional and reproductive health status in (early) adolescence (section 2.5). Finally, a conceptual model is presented whereby we bring into focus the further outline of this study (section 2.6). The chapter closes with a discussion of the conclusions (section 2.7).

2.2 Main theoretical concepts

Given that this study aims to understand adolescents' reproductive health status in view of early life conditions, a *lifecourse* approach is applied. Several concepts can be singled out while building a framework for the understanding of adolescents' reproductive health status and its (multi-)lifecourse determinants (Figure 2.1).

Figure 2.1: Main theoretical concepts



In this section we will elaborate upon process, lifecourse and context (subsection 2.2.1), trajectory or career and transitions (subsection 2.2.2) and the concepts of timing and duration (subsection 2.2.3). The last 2 concepts are discussed in terms of sensitive or critical periods and potential to catch up early life growth failure. We hereby build further on the extensively described *process-context* approach, a multidisciplinary theoretical approach adopted by HERA and worked out in detail by Willekens (1990; 1992), Hutter and Willekens (1998), Hutter (1998), de Bruijn (1999) and Mills (2000). This approach is in turn grounded on traditional demographic fertility and mortality models of Bongaarts and Potter (1983) and Mosley and Chen (1984) respectively, that together include most reproductive events and their determinants. Furthermore, the process-context approach relates to earlier and recent studies in social demography (Greenhalgh 1989; 1994; 1995), institutional economy (North 1994; Denzau and North 1994) and cognitive anthropology (D'Andrade 1984; 1992; 1995). Apart from the *process-context* approach, while setting up our theoretical framework we draw upon the glossary of *lifecourse epidemiology* (Kuh et al. 2003). "Lifecourse epidemiology starts from the premise that various (…) factors throughout life, independently, cumulatively, and interactively, influence health and disease" (Kuh and Hardy 2002, p. 5). In lifecourse epidemiology the main interest lies in the associations between (linked) exposures and disease risks at a later stage. We are primarily interested in the associations between malnutrition and the *timing* of reproductive transitions (menarche), whereby for instance a 'late' timing (of menarche) is one of the outcomes.

2.2.1 Lifecourse within the process-context approach

We work further from the notion that the *lifecourse* can be seen as a specificity of the concepts of *process* and *context* combined: the lifecourse refers to the structure of life within a particular *temporal order*, whereby specific transitions and hence stages (for instance gestation, infancy, childhood, adolescence and adulthood) can be distinguished, which are *contextually* defined. The structure of life is thus time-bound and space-bound (Willekens 1999, p. 25). Pending the subject of study, various temporal orders or dimensions of time are distinguished that should not be regarded as completely separate constructs but, in the words of de Bruijn (1999, pp. 144-147), rather as "simultaneously running clocks, but of a different magnitude". He outlines the following: historical or calendar time (the structuring into for instance years, months and days, examples being *chronological* and *gynaecological* age), institutional time (the evolution of various institutions that make up a specific context), social time (consisting of different stages, which are represented by distinct rules for relations with people, responsibilities, duties and behaviour), and biographical or individual time (the structuring in ages, age groups or life stages). The last mentioned is commonly referred to as the *lifecourse*, which encompasses and structures a broad range of life events pertaining to one individual within the period between his or her birth, or rather conception, and death. Next, we briefly elaborate upon the embedment of the concept of *lifecourse* within the *process-context* approach.

Process and lifecourse

An adolescent's nutritional and reproductive health status is a far from static individual trait but rather the compressed outcome of a nutritional and reproductive development *process*, comprising a series of specific statuses and general health and living conditions that are respectively occupied and encountered earlier in life. The pathways underlying nutritional and reproductive health status in adolescence are thus dynamic, i.e. they are processes (such as growth, maturation, health development, history of diseases) which are constantly re-formed over time. In general, a person can be regarded as being involved "in a continuous process of *becoming*" (de Bruijn 1999, p. 13).

One of the main rationales of lifecourse research is the interest in how current conditions or characteristics are influenced by conditions and experiences in the past. Lifecourse research is based on the notion that the basic life structure of individuals is universal and independent of (historical) time (Willekens 1999, p. 23), whereby life is considered to evolve according to the *epigenetic principle*, which entails that "development starts from a ground plan and out of that ground plan parts arise, whereby each part having its time of ascendancy, until all parts have arisen to form a functioning whole" (Willekens 2004). Examples of developmental processes that stem from the epigenetic principle are the processes of physical maturation and psychosocial development as formulated in the theory of Erikson from 1950 onwards (Erikson 1963; Sugarman 1986, p. 83; Zimbardo et al. 1993, p. 125; Erikson 1997). In the course of time, the concept of lifecourse has been defined in different ways and applied in multiple disciplines. Since reviews of the concept of the lifecourse have extensively been presented elsewhere (see for instance Berger 1996; Heinz 1997; Giele and Elder Jr. 1998; Dykstra and van Wissen 1999; Willekens 1999), within the scope of this study it suffices to say that lifecourse and longitudinal research (i.e. analyses of repeated characteristics of the same person) is:

- concerned with *process(es)* (for instance the lifecourse "progresses through time" (Clausen cited by Berger 1996, p. 129) and can be seen as "a complex and composite developmental process" (Willekens 1999, p. 29; Willekens 2004), and is thus dynamic);
- constituted by *stages* which are distinguished by *transitions* that give the lifecourse a "life structure" (Willekens 1999, p. 23); and
- embedded within a social and historical time *context*, i.e. there is "interplay between individual biography and social and historical processes" (Clausen cited by Berger 1996, p. 129; Hareven cited by Berger 1996, p. 131). Runyan (1982, p. 82) views for instance the historical context primarily as a background against which individuals act.

Context and lifecourse

The concept of context is defined by de Bruijn (1999, p. 251) as "the (institutionally) structured environment from which individual actors deduce information about options and constraints for behaviour and the values attached to these". The word 'structured' in this definition points to an order or grouping according to a certain plan or set of ideas. The 'overall' context is structured, because it is - in its most abstract form - too complex to deal with. In practice, actors structure *the overall context* by distinguishing *various contexts* according to cognitive or mental schemas[8]. By doing so they transform the unstructured context into *their* contexts: contexts are interpreted,

8 A schema can be seen as a conceptual structure or mental map, which makes the identification of objects and events possible; they are learned as part of socialisation and they are culturally determined (D'Andrade 1992, cited by Hutter 1998, p. 10). An example of schema is how menstruation is perceived to be 'polluting' in Bangladeshi society, as described in section 2.4.3.

understood, and eventually defined by the actors they relate to. A part of the context consists of 'meaning systems', encompassing for instance cultural schemas, which are shared by a group of people (D'Andrade 1984, cited by Hutter 1998, p. 15). Thus actors structure and give meaning to their context.

Following de Bruijn (1999, p. 131), conceptually three levels of contexts are distinguished: the *micro*-level context refers to the individual and his or her interactions with immediate others, the *meso*-level context refers to (community) institutions and organisations, and the *macro*-level context applies to the society. Although generally not made explicit, individual characteristics also include '*inner-micro*-level' traits such as one's genetic make-up. Genes direct the process of maturation according to a systematic and predictable sequence (the genetically-based timetable or 'blueprint'). Genes however only control the range of effects that the environment can have in shaping one's phenotype (Zimbardo et al. 1993, p. 47). Whereas genes, or *heredity,* set a reaction range of potential, *experience* determines where in that range any individual will be. For example, in the field of anthropometry, it is *heredity* that determines how tall one can grow, whereas how tall one actually becomes depends partly on *nutrition* (Zimbardo et al. 1993, pp. 120-121). In line with the 'consensus' reached within the long-standing '*nature-nurture*' debate, neither one of the extreme positions, '*nature*' (genetic inheritance, de facto genes) or '*nurture*' (external, environmental, inputs), is accountable for an individual's biological, and hence nutritional, constitution, but these two influences are constantly interacting with each other. With regard to environmental inputs, Berger (1996, pp. 132-133) distinguishes the following influences:

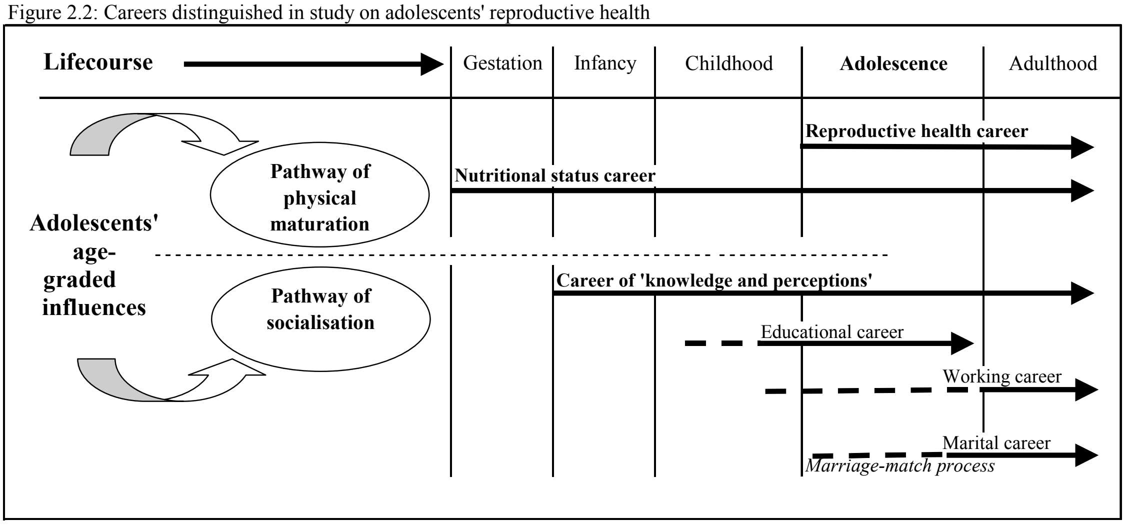
- *age-graded influences*, which entail those aspects of development that are related to chronological age as well as age-specific societal expectations;
- *history-graded influences*, which are societal changes brought by historical events (for instance war); and
- *non-normative influences*, which constitute events such as accidents and natural catastrophes as well as unanticipated and unpredicted occurrences (for instance the loss of a parent and - common to Bangladesh - floods and famine).

This study addresses *adolescents' age-graded influences* on reproductive health status, such as adolescents' nutritional status and the process of socialisation. Both processes progress by age and are conceptually situated at the *micro* level. Nutritional status development is generally indicated by (chronological) *age-specific anthropometric indices* and socialisation is closely linked to *age-specific societal expectations*. Adolescents' reproductive health is also subject to *higher-level* contextual influences. This can be illustrated for instance by looking at adolescents' nutritional intake which underlies their nutritional status and which is in turn one of the most important non-genetic determinants of menarche, as we will elaborate in subsection 2.4.2. Adolescents' nutritional intake is facilitated or inhibited by the *cultural* context (for instance, the allocation of food within the household is associated with gender-specific societal values), the *economic* context (a household's expenditure on food is for instance mainly determined by the income generated by its members) and the *ecological* context (the cyclical rhythm of the natural environment determines for instance the onset and ending of harvest seasons, and hence the periods of food scarcity and abundance). With regard to *higher-level* contextual influences on adolescents' reproductive knowledge and perceptions - the mental component of their reproductive health status (see section 1.3) - we study for instance *socio-cultural* aspects of the process of socialisation taking place in Matlab and Bangladeshi society at large.

2.2.2 Careers and transitions

Within a lifecourse, *trajectories* can be distinguished that provide a long-term view of one dimension of an individual's life over time (Kuh et al. 2003, p. 12). Such a notion resembles the concept of *career*, i.e. a domain-specific developmental process, or the chain of events and experiences that pertain to one particular sphere of the individual's life (Willekens 1999, p. 37). Examples from the pathway of physical maturation are the *nutritional status career*, which is built up of a series of nutritional status over the lifecourse, and the *reproductive health career* (as illustrated in Figure 2.2). These careers are further discussed in section 2.3 and 2.4 respectively.

Figure 2.2: Careers distinguished in study on adolescents' reproductive health



Life events, experiences, states and situations often occur simultaneously. De Bruijn (1999, pp. 153-157) refers to the lifecourse as an organising principle for the synchronous and diachronous aspects of the individual life. Synchronous organisation relates to careers that are *intertwining* and (partly running) parallel (de Bruijn 1999, p. 186). An example of a parallel career related to the nutritional status career is the marital career whose onset will briefly be discussed in section 2.5. Other partially parallel careers are the educational and working careers upon we briefly touch. Social ramifications of adolescent childbearing on educational and work opportunities (see, for instance, TAGI 1996; Buvinic 1998) are however not addressed within this study.

The second or diachronic type of organisation of a lifecourse relates to the notion of *conditional* careers (de Bruijn 1999, p. 186). A *conditional* career is a parallel career that provides the resources and constraints for achieving the goals set in a particular career (Mulder 1993, p. 25). This perspective suggests a causal relation between conditions or processes over time (de Bruijn 1999, p. 186). An adolescent's nutritional status career is closely related to his or her reproductive health career, whereby usually the former is considered to be conditional to the latter. For instance, in order to successfully pass or go through reproductive health events or developments, such as a pregnancy, one needs to have an adequate nutritional status. Also, an adequate nutritional status, for example reflected by a certain ‘critical’ weight (Frisch and Revelle 1971), is believed to be a prerequisite for a timely menarche, as will be outlined in subsection 2.4.2. The relationship is however in some cases reversed (although not necessarily conditional): some events situated within the reproductive health career impact nutritional status, and hence, the nutritional status career; the most obvious example being pregnancy that increases a woman’s weight and hence her nutritional status.

Apart from the nutritional and reproductive health career, a ‘career of knowledge and perceptions’ may be distinguished, embedded within the pathway of *socialisation*, i.e. “the adoption of the behaviour patterns of the surrounding culture” (Webster 2004) or, more specifically, “the process by which the individual learns and adopts the various ways, ideas, beliefs, values and standards of his culture and incorporates them into his personality” (Davis cited by Monroy de Velasco 1985, p. 20). How adolescents in Bangladesh experience the reproductive transitions encountered during this stage of life, and how they cope with culturally-subscribed social roles, cannot be fully understood without taking into account the way adolescents have been socialised. Particularly the development of emotional maturity seems closely linked to the process of socialisation as, in the words of Lewin (cited by Monroy de Velasco 1985, p. 19) “adolescence is a period of transition in which the young person changes to the group to which he belongs”. It is in childhood that the foundations are laid for patterns of behaviour in adolescence and adulthood and based on the lifetime accumulation of knowledge and experiences, social roles are internalised. In Bangladeshi society, these roles seem to a large extent gender-specific: a girl grows up to get married and to become a good wife and mother (White 1992, p. 97), whereas a boy’s education entails “developing the ability to earn a living, marry and produce children, and becoming a respectable member of the *samaj*” or society (Blanchet 1996, p. 49). The pathway underlying the ways in which people are prepared for roles that culture assumes they will perform, the hidden curriculum, includes *anticipatory socialisation* and *socialised anxiety* (Berger 1996, p. 132).

This ‘career of knowledge and perceptions’, which we will study for adolescents, could also be viewed against the aforementioned theory of Erikson on psychosocial development (Erikson 1963). Erikson distinguishes psychosocial stages of development and refined and expanded the stages earlier identified by Freud. Erikson identified eight stages (later expanded to nine) that together make up the entire cycle of life. Also Erikson’s work stems from the *epigenetic principle*: in his view people develop through a predetermined unfolding of personalities in stages whereby progress through each stage is in part determined by success or lack of success with acquiring certain developmental tasks in previous stages (*developmental readiness*). Central to the adolescent stage is the development of *identity* whereby adolescents who have not been able to develop a basic sense of trust during infancy face the risk of suffering from an identity crisis (Zimbardo et al. 1993, p. 148). Identity development includes elements like coming to terms with sexuality, one’s appearance, and internalising social roles. Erikson’s theory has formed the basis of an anthropological study by Aziz and Maloney (1985) that describes the stages in life in Matlab, Bangladesh. Based on their work, a background sketch of the social significance of the period of adolescence in Matlab is presented on the basis of secondary literature in subsection 2.4.3.

Transitions

Within careers, *transitions* can be distinguished that are "status passages that mark socially significant points of change in people's lives" (Dykstra and van Wissen 1999, p. 6), whereby we should note that in our study they also entail *physically* important points of change (menarche, spermarche). Not only the transition itself but also its timing may have social connotations. If viewed in relation to other transitions, a transition can be labelled as earlier, later or simultaneously. Since there is considerable variability in the timing of events, individuals internalise *social clocks* and often gauge their progression through life accordingly (Berger 1996, p. 130). As with social roles, *social clocks* are constructed on the basis of *social norms*. It is also on the basis of these norms that events or behaviours can be evaluated in terms of 'on timeness' or 'age appropriateness' (Berger 1996, p 130; p. 134), labels often charged with emotional intensity and which can only be understood by taking the broader socio-cultural context into account. The timing of menarche has physical implications, but is also associated with certain age-related norms and behaviours that reflect the social significance of 'late-bloomers' or 'precociousness'. Adolescent reproductive transitions are studied from both angles (physical and social) in section 2.4.

2.2.3 Sensitive or critical periods in relation to catch-up growth

The *timing* of two succeeding transitions determines the *duration* of a certain state. With respect to the pathway(s) underlying nutritional status at a given moment in time, it is important to know about the *timing* of a status change (for instance turning from well nourished into malnourished at age x), and the *duration* of this state (for instance being malnourished for y months). Timing and duration of malnutrition may both influence the likelihood of recovering from growth failure effectively later in life, and hence, impact the pace of the overall and reproductive maturation process.

The notions of *timing* and *duration* can be linked to specific periods distinguished within the nutritional status career, during which the effects of inadequate food intake and infections may have a detrimental, and possibly lasting, impact on (reproductive) health later in life. In this subsection, these special time windows - *sensitive* or *critical* periods during which the foundations are laid for the further course or pace of the developmental process - are juxtaposed against the catch-up potential of faltering growth[9] in early life for adolescents. Studies on the long-term consequences of impaired nutritional status in the early stages of life have mainly been the domain of epidemiologists (for instance Elo and Preston 1992; Kuh and Ben-Shlomo 1997; Kuh and Hardy 2002; Ben-Shlomo and Kuh 2002). Although the timeframe of our study is considerably shorter (up to early adolescence), it is also here that common ground is found with research conducted by for instance Barker and his colleagues who investigated the foetal and infant origins of several adult diseases, among which include ischemic heart disease, stroke, chronic bronchitis and coronary heart disease (see for instance Barker 1992; 1993; 1998; Eriksson et al. 1999; Barker et al. 2001).

[9] Though 'growth' generally refers to all systems of the body, in our study this concept is narrowed down to 'somatic growth', i.e. growth of body size (height) or mass (weight) (Bianculli 1985, p. 45).

Programming

The rationale for identifying *critical* or *sensitive* time windows is that all forms of experience are not equally important to all stages in development (Bateson 2001, p. 931). In research conducted by Barker and his colleagues a *sensitive* period generally extends back to the period of gestation and infancy (Robinson 1992, p. 2). Their 'foetal origins of disease hypothesis' stems from the assumption that in utero nutritional deprivation may alter the baby's growth, physiology and metabolism - changes that are believed to tend to persist through life (Barker 1993, p. 1). The sensitivity or critical character of a period relates to the concept of 'metabolic programming', meaning that an early stimulus or insult, operating at a critical or sensitive period, results in a long-term change in the structure or function of the organism (Robinson 1992, p. 2). Epidemiologists such as Kuh et al. (2003, p. 5) view a *critical period* as a limited time window in which an exposure can have adverse or protective effects on development and subsequent disease outcome. Within the nutritional status career, the hypothetical set of adaptations set in utero resulting in babies with a low weight at birth and a specific metabolic and cardiovascular make-up, is also referred to as the 'thrifty phenotype' (Bateson 2001, p. 930). Central to studies undertaken by Barker and advocates is that babies with thrifty phenotypes, i.e. babies who are 'designed' to live in an environment that is chronically short on food, and who subsequently grow up in affluent environments "may operate sub-optimally" (Bateson 2001, p. 931). As we will outline below, in Bangladesh, however, postnatal nutritional conditions are also often poor. The processes of positive or negative adaptations in the face of malnutrition refer to what is labelled by Kuh et al. (2003, p. 8) as extent of *resilience* and *vulnerability* respectively.

Also within the discipline of developmental psychology - see for instance Freud's theory on psychosexual development (published on since 1900), Piaget's theory on cognitive development (1970), and Erikson's theory on psychosocial development (1963; 1997) - *sensitive* or *critical* time windows are distinguished, whereby a *sensitive* or *critical* period is defined as a time during development when an organism is optimally ready to acquire a particular behaviour if certain stimuli and experiences occur. If these stimuli and experiences do not occur the organism does not develop the behaviour at that time and it will subsequently encounter difficulties in acquiring a particular behaviour (Zimbardo et al. 1993, p. 125).

Cumulative causation

An alternative hypothesis within epidemiology - that of *cumulative causation* - refers to the accumulation of risk (chain of risks) during a lifecourse, which suggests that throughout the lifecourse exposures or insults gradually accumulated through episodes of illness, adverse environmental conditions and behaviours increase the risk of chronic disease and mortality (Kuh and Ben-Shlomo 1997, p. 6). Regarding Bangladesh, there is a well-documented list of factors (notably infectious diseases, diarrhoea, adverse behaviours and living conditions) that contribute in the negative to the *'chain of risks'* impacting nutritional anthropometry. We will come back to some of these factors in section 2.3.1.

Mindful of the aforementioned definition of Barker and the 'cumulative risk hypothesis', in this study we focus on timing of menarche in particular in relation to contemporary and early life nutritional status, whereby we review certain critical time windows (birth, early childhood). This study aims to understand whether and how certain conditions (malnutrition, notably stunting, i.e. being short for age) in early life have a (statistically significant) long-lasting effect on adolescent nutritional status and particularly the timing of menarche. We will not study empirically the early life origins of adolescents' reproductive knowledge and perceptions. It is however acknowledged that during childhood and adolescence abilities, skills, habits, attitudes and values are accumulated and that they may strongly impact health (behaviour) later in life (Kuh and Hardy 2003, p. 7).

Studies that engage in the 'foetal origins of adult disease hypothesis' have been criticised among others for failure to adjust for postnatal conditions or changes *in between* the foetal stage and the current outcome (in adulthood), mainly due to a lack of data, as well as failure to explore the *relative* contribution of prenatal and postnatal factors (Lucas et al. 1999). The timeframe in our study entails the time span between birth and adolescence, whereby we take explicitly into account nutritional status *in between*, i.e. in early childhood. Given the association between maternal stature and that of her child (Silventoinen 2000, p. 16) and age at menarche between mothers and daughters (Gray 1993, p. 220), we also account for possible inherited influences indicated by height of the adolescent's mother and maternal age at menarche.

Catch-up growth

Faltering growth in early childhood does not necessarily lead to stunting later in life because of the potential of catch-up growth. Catch-up growth is defined as the recovering of a delay in growth, a process first identified in plants and animals but later also in human beings (Silventoinen 2000, p. 22), or a 'reduction of the deficit'. Two types of catch-up growth can be distinguished. The first type is an increase in growth velocity beyond the normal velocity for the chronological age, which is only possible when the environment that affects the slowed growth improves; the second type of catch-up growth is characterised by a growth that continues longer than usual while growth velocity does not change (Silventoinen 2000, p. 22). This second type is in most cases impossible to distinguish from normal puberty growth acceleration (Ibid. 2000, p. 22) and is also referred to as 'spontaneous' catch-up growth (WHO 2003, p. 23). Catch-up growth may also comprise a combination of the two types.

Regarding the catch-up potential of an individual it is important to know at what stage the growth curve slowed down. Because growth processes differ in pace - neural growth occurs for instance very rapidly in the first year of life and is much faster than overall physical growth whereas genital maturation does not occur until adolescence (Zimbardo et al. 1993, p. 122) - stages of development are identified within the overall process of physical growth. On the basis of longitudinal data on growth velocity by age and sex a growth curve can be modelled. The shape of the growth curve is non-linear: infancy is characterised by rapid, although decelerating, growth; in childhood growth is more or less constant or slightly decelerating; whereas in adolescence the final growth spurt sets in (Bianculli 1985, p. 47; Heald 1985, p. 51).

Apart from the period of gestation, growth velocity never becomes faster than in infancy. Consequently, growth faltering in infancy is most detrimental, in the sense that "stunting at this phase is more difficult to recover in the future than a delay during a later age" (Silventoinen 2000, p. 23). Substantial, if complete, recovery of severely stunted children is possible particularly in situations where growth is delayed, not due to poor environment, but to some temporary treatable factor such as celiac disease or a reduced growth hormone secretion (Ibid. 2000, p. 23). However, the potential for catch up faltering growth (stunting) in childhood is believed to be limited *after the age of two years*, particularly when such children remain in poor environments (Gillespie and Flores 2000, p. 2). Catch-up growth may be identified by looking at the timing of ‘adiposity rebound’, which refers to the age at which the Body Mass Index (BMI) reaches its lowest point in childhood and which is usually at the age of five or six years (Colhoun and Chaturvedi 2002, p. 130; Power and Parsons 2002, p. 308). As outlined by WHO (2003, p. 10), in terms of nutrition, the period of adolescence is also critical because of:

- the dramatic increase in physical growth and the related requirements of (extra) nutrients. In adolescence, 15 to 20 per cent of adult height and 25 to 50 per cent of adult weight is gained, whereas approximately 45 per cent of skeletal mass is added during this period (WHO 2003, p. 10; Abassi 1998, pp. 507-511);
- socio-cultural factors or change in lifestyles and food habits influencing nutrient intake and needs;
- the increase in nutrients during specific periods such as illness and pregnancy; and
- the fact that adolescence could be the (second) opportunity in life to catch up growth if environmental (nutritional) conditions are favourable.

In practice however the potential for significant catch-up in adolescence is small and may be limited to the brief period of pre-pubertal growth spurt, some 18-24 months immediately preceding menarche (WHO 2003, p. 22). Given the rapid growth, particularly these two years in which the peak in growth velocity is reached, adolescence is a ‘critical period’ (Bassey et al. 2002, p. 148). Catch-up growth, notably taking the form of an above-average BMI or weight gain following low birth weight, may also be detrimental as it is for instance associated with higher death rates from coronary heart disease (Eriksson et al. 1999, pp. 427-431).

Catch-up potential depends on contextual factors, particularly living conditions, and it may be influenced by intrinsic factors such as sex, or rather, sex-specific traits related to growth development. Timing and tempo of changes in height, weight and body composition in adolescence vary greatly (WHO 2003, p. 10). Boys and girls have different rates of growth during adolescence (Bianculli 1985, pp. 49-53) and the spurt occurs two years later in boys than in girls, but is greater and lasts longer in boys (Lachance 1995, p. 7; WHO 2003, p. 10). Lean body mass may attain its adult level as early as by the fourteenth year in girls (Heald 1985, p. 52) but the growth spurt usually subsides at the age of sixteen (Bassey et al. 2002, p. 148). In boys adult height is reached later, possibly as late as at the ages 17 to 18 years (Heald 1985, p. 52). This difference is believed to underlie the approximate 10 cm difference in adult height between men and women. As girls enter puberty two years earlier than boys, their growth ceases at least two years before that of boys, and these two years also represent the years of peak height velocity for each sex (Heald 1985, p. 53).

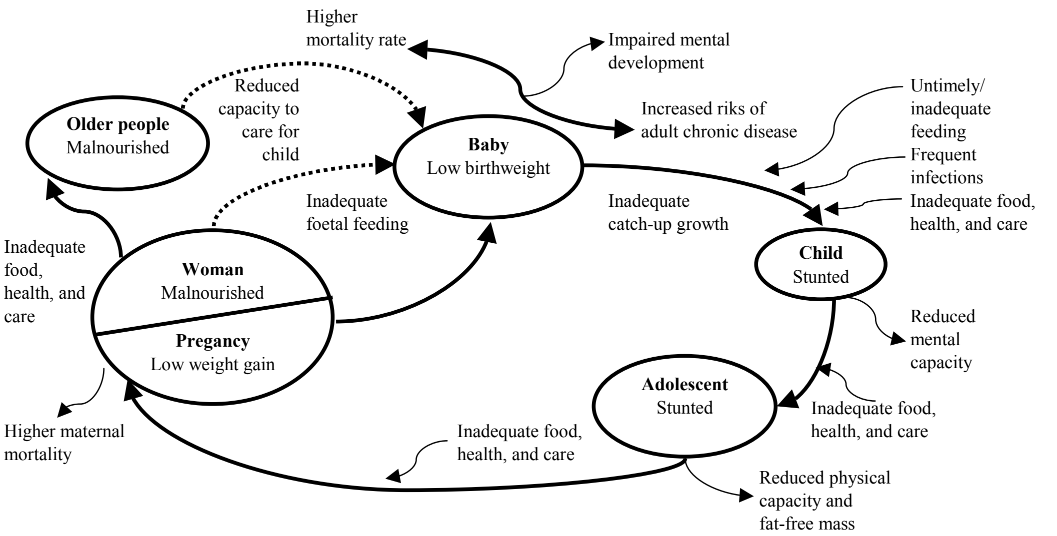
In sum, the physical indicators of adolescents’ reproductive health status (menarche, spermarche) are viewed within the lifecourse, and more specifically, within the reproductive health career, which is in turn closely related to the nutritional status career. Mental indicators of adolescents’ reproductive health status that we consider are viewed within the ‘career of knowledge and perceptions’, that may be influenced by the broader process of socialisation. Some developmental time windows earlier in life may be distinguished because of their 'critical' or 'sensitive' nature, meaning - simply put - that any enhancing or detrimental status or experiences in these periods have long-term implications. Within the process of physical maturation, critical periods that one may consider are gestation (growth in utero, which may be reflected, albeit crudely, by birth weight) and specifically early childhood. Detrimental effects of early life malnutrition may to some extent be counterbalanced at a later stage in life if living conditions improve. The potential for and type of catch-up growth may be sex-specific and influenced by timing and extent (duration and severity) of malnutrition. Such special time windows are distinguished also within developmental psychology. Reviewing multi-dimensional development processes, Jenniskens and Verduin (1998, p. 17) outline four points in life at which it is not possible to catch up on deficits (also called 'points of no return', i.e. interventions cannot make up the deficit), respectively at birth, at 12 months (brain development), at 3 years (height and mental development) and adolescence (behaviour).

2.3 From birth to childhood: laying the foundations of adolescent anthropometry

In this section the role of early life nutritional status for nutritional status in adolescence is discussed. Figure 2.3 describes the *lifecourse* (life cycle) approach to nutritional status development within a largely malnourished population, as adopted from the United Nations Sub-Committee on Nutrition (United Nations 2000, p. 1). The (interrelated) effects of early life growth failure may be passed on from one stage in life to the next, via the mechanisms of '*programming*' as proposed by Barker (1992) and '*cumulative nutritional deprivation'* (see subsection 2.2.3), and could consequently be passed on to the next generation, resulting in an intergenerational cycle of growth failure. The cycle starts at birth. Low birth weight (LBW) is an *intergenerational* problem since LBW babies can grow up to become undernourished and stunted children and adolescents, and ultimately malnourished women of childbearing age, who in turn are more likely to deliver LBW babies, particularly when the 'woman' is in fact an adolescent girl who became pregnant before her own growth was completed (Pojda and Kelley 2000, p. 2).

Our research stems from the assumption that birth weight and, relative to age, weight and height in early childhood create a predisposition to nutritional status in adolescence (*pathway of physical maturation*, subsection 2.3.1). In addition, the nutritional status in early childhood and adolescence is influenced by living conditions of the household, gender and the way the adolescent is raised (*pathway of socialisation*, subsection 2.3.2). Both pathways are also outlined in Figure 2.2 (subsection 2.2.2). Subsequently, we elaborate further upon this model while discussing the consequences of early life malnutrition and 'late' timing of menarche, expressed by young *gynaecological age*, on adolescent childbearing (sections 2.5 and 2.6).

Figure 2.3: Nutrition throughout the life cycle



Source: United Nations (2000, p. 8)

2.3.1 Physical maturation: programming and cumulative causation

Viewed from the lifecourse perspective, reaching the adolescent stage implies having survived all previous stages in life. From a developmental point of view, life starts at conception: "a child at birth is already nine months old" (Cameron and Hofvander 1983, p. 1). In the same vein, Mosley (1979, p. 120) remarked that "the road to health begins at the moment of conception". Constitution at birth is a function of genetic inheritance in conjunction with intrauterine factors (in utero nutritional and environmental conditions). Under optimal conditions normal birth weight in Europe and North America ranges between 3.3 and 3.5 kg irrespective of sex, whereas the average infant (*in general*) is 50 cm long at birth (Cameron and Hofvander 1983, pp. 1-6). In Bangladesh, 50 per cent of the children are born with a birth weight below 2500 grams (WHO 2003, p. 8). Such a birth weight is commonly used as a proxy for intrauterine growth retardation as particularly in developing countries data on gestational age are often lacking (United Nations 2000, pp. 2-3).

The study on the relative contribution of genetic inheritance and intrauterine factors on weight and size at birth is ongoing[10, 11] and, to date, findings are inconclusive (see

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[10] In the Netherlands, Amsterdam researchers recently started the so-called ABCD study (Amsterdam-Born Children and their Development), which aims to understand the role of lifestyle and ethnicity on birth outcome (announced in Zorgnieuws 2003, p. 3).

[11] In Matlab, ICDDR,B is currently conducting a study to measure the impact of nutritional supplementation (food and micronutrients) during the first trimester of pregnancy, whereby they look specifically at nutritional status in pregnancy, maternal weight gain, and foetal growth as detected by ultrasound. This study is undertaken as part of the 'LBW-Initiative' or 'MINImat' project (ICDDR,B 2002b, p. 41). Putting the first trimester of pregnancy, as a critical time window, central is highly relevant as such, but more insight may be gained if other trimesters are considered as well. Findings of Stein et al. (1995, p. 135) on the Dutch Famine Birth Cohort suggest that there may be cumulative effects of severe nutritional deprivation during pregnancy on birth size, which may be trimester-specific and only hold below a certain threshold. Intrauterine growth retardation in the third trimester may be due to poor placenta development in the early stages of pregnancy (van der Veen 2001, p. 57).

for instance Kramer 1987a; Kramer 1987b; Hutter 1994; Kusin and Sri Kardjati 1994; Padmadas 2000; Pojda and Kelly 2000; van der Veen 2001; Osendarp 2001; den Draak 2003; Fairly and Taylor 2003; Diamond 2004), as is the study on its relation to early life anthropometry and health later in life (see studies by Barker and his colleagues). Basically, low pre-pregnancy nutritional status and insufficient weight gain of the mother during pregnancy are believed to be main causes for LBW babies (Riley 1994, p. 97; Gillespie and Flores 2000, p. 1). In line with the Barker hypothesis, findings of Roseboom et al. (2001) suggest that maternal malnutrition during gestation may permanently affect adult health without affecting the *size* of the baby at birth. There may thus be 'hidden' (*programmed*) impairments, which possibly take effect years later. Also, there may be a 'sleeper effect' meaning that effects of starvation are not passed on the next generation but to the next generation's *offspring*, i.e. children are marked by the deprivations suffered years earlier by their grandmothers. Evidence for such an effect is provided by research based on the *Dutch Famine Birth Cohort*, which consists of children born in Amsterdam during the so-called 'Hunger Winter', i.e. between 1-8-1944 and 15-4-1945 (Diamond 2004).

In Bangladesh, maternal nutritional status both *before* and *during* pregnancy is low. For instance, more than 50 per cent of the women in this country are underweight (Gillespie and Flores 2000, p. 3). Particularly, rural Bangladeshi women are considered to be chronically malnourished (Fauveau 1994, p. 111). In Bangladesh, 57 per cent of the rural (poor) women are less than 147 centimetres in height as a result of stunting, virtually all mothers weigh less than 50 kg (Ross et al. 1996, p. 10) and 47 per cent is underweight according to BMI (i.e. BMI[12] was 18 or lower) (WHO 2003, p. 8). Another study reports an average height of Bangladeshi women of nearly 150 cm (Riley 1994, p. 97). During pregnancy, weight gain is often insufficient due to strenuous activities, infectious diseases (Fauveau and Chakraborty 1994, p. 115) or taboos on food intake (Fauveau 1994, pp. 267).

Maternal height (and to a lesser extent weight) is one of the anthropometric indicators that we include in our study and which is part of the broad list of factors that contribute to a particular birth outcome (see for a complete list for instance van der Veen 2001, pp. 53-58). There is evidence supporting the hereditary nature of an impaired nutritional status: low height may become an embedded trait and passed on from mother to child. The role of genetics is reflected by the association between children's birth weight and that of their mothers, and birth weight of siblings tend to be similar to each other (van der Veen 2001, pp. 53-58). This effect also holds later in life: a mother's stature is probably the best predictor of a child's height (Silventoinen 2000, p. 16). In addition, a mother's BMI was found to be strongly positively related to height and BMI of her sons at the ages 7 to 15 years (Eriksson et al. 1999, pp. 427-431). The transmission from the paternal side seems far less influential (Silventoinen 2001, p. 16; van der Veen 2001, pp. 53-58).

In Bangladesh, also *after* birth nutritional status is likely to be inadequate: almost 60 per cent of the under-fives suffers from malnutrition (ICDDR,B 2002b, p. 36). It is estimated that in rural Bangladesh malnutrition accounts for 33 to 67 per cent of the deaths of 1 to 4-year-old children (Fauveau 1994, p. 251). In 1993-1995, 58 per cent

[12] A BMI of 18.5 or lower indicates underweight (see also subsection 3.3.2).

of the under-fives was wasted (low[13] weight-for-height), 55 per cent was stunted (low height-for-age) and 73 per cent was anaemic (WHO 2003, p. 8). Particularly in the 12 to 23-month-age group, rural children in Bangladesh suffer from acute malnutrition (Ross et al. 1996, p. 10). In the study of Baqui (1990), which serves as our baseline study (see Chapter 3), the proportion of under-five children who were underweight (<-2 SD) ranged from 73 per cent to 78 per cent in 1988-1989 (depending the three-month period considered within these two years). The corresponding data for childhood stunting (<-2 SD) ranged from 68 and 76 per cent, respectively. The most common deficiency disease among young children is *protein energy malnutrition* (PEM), which entails weight deficit and linear growth failure (FAO 1992, p. 53; WHO 2003, p. 10). Children need, relative to their body weight, much energy and protein-rich food (Leemhuis-de Regt 1998, p. 9).

A cumulated list of factors underlies malnutrition among Bangladeshi children. Although PEM is primarily caused by a deficient intake of energy and usually protein, the condition is almost always aggravated by repeated episodes of diarrhoea and other infections for which especially young children are more susceptible. Wasted and stunted children are more prone to illness than well-nourished children, and diarrhoea and respiratory episodes are more likely to progress in severity in stunted children (Baqui et al. 1993b; Lachance 1995, p. 8). A child's susceptibility to infectious diseases is exacerbated by poor or unfavourable living conditions. It is however difficult to disentangle the detrimental effects of infectious diseases from the impact of malnutrition as they often go hand in hand: being malnourished may increase the susceptibility to infectious diseases, while illness may lower the nutritional intake (WHO 1968; Norren van and van Vianen 1986). As a result of this synergistic relationship, children may suffer from malnutrition even during times of affluence, for instance during harvest seasons, when diet is adequate but infection may continue to be present (Hellen Keller International 1993, p. 7).

Diarrhoeal diseases are heterogeneous. In Matlab, dysentery (diarrhoea with blood) stands out as the one with most deleterious consequences on both ponderal and linear growth (Alam 2001, p. 109), and the impact is dependent on the proportion of dysenteric episodes in the total diarrhoea burden (Alam et al. 2000a, pp. 916-921). Diarrhoeal diseases caused 56 per cent of the deaths among 1 to 4-year-old children in Matlab (*Comparison* area; see section 3.4) between 1978 and 1987 (Fauveau 1994, p. 177; Ross et al. 1996, p. 12). The incidence of diarrhoea tends to increase rapidly when complementary foods are given and particular when breastfeeding is stopped. Diarrhoea is therefore particularly common in the second year of life and is then referred to as 'weanling diarrhoea' (Cameron and Hofvander 1983, p.33). However, more and more, weaning starts at an earlier age. In Matlab, exclusively breastfed infants account for 70 per cent at 3 months and 37 per cent at 6 months (Alam 2001, p. 90). Onset of weaning, either too early or too late, may have detrimental effects on health and nutritional status. Among Indian children the timing of initiation of weaning is associated with stunting: children weaned at an age of 6 months or older were more likely to be stunted at a later age as compared to those weaned before 6 months, with odds ratios of 1.57 and 1.88 respectively (Padmadas 2000, p. 181; Padmadas et al. 2002, p. 855).

[13] Below -2 Standard Deviation (SD) from the median of a well-nourished reference population (see also subsection 3.3.2).

Consequences of low birth weight and early childhood malnutrition

Short-term effects of LBW (higher morbidity and mortality particularly from infectious diseases) are in general well documented, although the link with for instance *perinatal* mortality (mortality in the period of the 28th week of gestation to the first week after birth) is not yet fully understood (Melve and Skaerven 2003; Wilcox 2003). The risk of *neonatal* death (deaths taking place within the first 28 days of life) is estimated to be 10 times higher for infants weighing 2 to 2.5 kilograms as compared to those weighing 3 to 3.5 kilograms (Gillespie and Flores 2000, p. 1). LBW babies typically have impairment of most immune functions and face an increased risk of diarrhoea and pneumonia (Gillespie and Flores 2000, p. 1). Razzaque (1989) found that for children conceived during the 1974-1975 famine in Bangladesh child mortality in the first two years of life in the period following the famine was higher.

A number of studies have tested the 'foetal origins hypothesis' and *long-term* outcomes of LBW have been published for many adult diseases, among which include ischemic heart disease, stroke, chronic bronchitis and coronary heart disease (see for instance Barker 1992; 1993; 1998; Eriksson et al. 1999; Barker et al. 2001). Also for girls born with a *very* low birth weight (i.e. below 1500 grams) an association was found with higher risk of *pregnancy-induced hypertension* (PIH) in their first pregnancy (Innes et al. 2003, pp. 861). Birth weight has also been shown to be positively related to subsequent fatness indicated by BMI at the ages 7, 11, 16, 23 and 33 years, in a J-shaped fashion with increasing age, but maternal weight largely explained the relation between birth weight and BMI at age 33 (Parsons et al. 2001). Cheung et al. (2002, p. 335) pointed out that the impact of a smaller size at birth may be compensated by a higher postnatal weight gain. They found birth weight and weight gain from birth to the age of 7 years to be inversely related to psychological distress in adults at the ages 23, 33 and 43 years. All in all, long-term effects of LBW have been studied but often entail a broader timeframe beyond the period of early childhood or adolescence. Also little is known about the mechanism of in utero programming on adolescent anthropometry.

Postnatal nutritional status, notably height in early childhood, remains crucial. In the *short term*, an inadequate dietary intake in the first years of life results in weight loss, growth faltering, lowered immunity and mucosal damage, which in turn elevates the risks of infectious diseases. In addition, the metabolic system may be further altered. Regarding *long-term* effects, in a recent review by Cole (2000, p. 323) on secular trends in growth, it was concluded that "the increment in adult height is achieved by the age of two years" and he suggests that "growth at this time is the outcome of an interaction between concurrent nutrition and the growth rate set during pregnancy, reflecting parental size". Accordingly, it is believed that although some of the height differences between people are attributed to genetics, the general trend for average height to increase is almost certainly due to improvements in nutrition, and to a lesser extent, health (Bateson 2001, p. 930).

Chronic malnutrition and disease in childhood may stunt growth and potential adult height may not be reached (Bassey et al. 2002, p. 148). Regarding catch-up potential, there is little evidence that growth retardation suffered in early childhood can indeed be significantly compensated for in adolescence (WHO 2003, p. 22). Similarly, there is as yet, little evidence (and research) on the effects of supplementary feeding on adolescent girls to prevent adult stunting (Leemhuis-de Regt 1998 p. 70). An exception is the two-generation study undertaken in Guatemala, which entails a prospective investigation of protein-energy supplementation early in life and growth of subsequent generation and which considers data collected between the years 1969 and 1977 and between the years 1996 and 1999 (Stein et al. 2003 pp. 162-167). The study showed that nutritional supplementation in childhood has positive effects on both the supplemented individuals as well as on subsequent generation, whereby the effect was more pronounced in (second-generation) boys than in girls. Within the context of fetal programming boys are in general more sensitive to nutritional deprivation than girls (Barker 1998). However, during infancy and childhood the opposite - girls being more vulnerable than boys - may be true with regard to intra-household allocation of food and care within Bangladeshi society, as will be outlined in the next subsection 2.3.2.

2.3.2 Socialisation: gender and the 'accumulation of nutritional capital'

Adolescents' reproductive health is usually studied in relation to various contemporary factors, with special emphasis on differences by sex or gender. Whereas sex refers to biologically-based characteristics, gender is a social and psychological phenomenon referring to learned sex-related behaviours and attitudes. Gender identity incorporates an individual's sense of 'maleness' and 'femaleness' and awareness and acceptance of one's sex (Zimbardo et al. 1993, pp. 144-145). The mechanisms through which gender is related to behaviour are often rather indiscernible, reflecting informal social rules and modes of conduct, among which are those directly related to nutrition and health.

As noted by Kuh and Hardy (2002, p. 13), the inquiry into gender inequalities in health usually lacked a temporal perspective, and it was certainly one that neglected childhood. During infancy and childhood, morbidity and mortality increasingly become a reflection of the competency of parental care, and it is only after 5 years that the child is able to extend at least a minimum level of care for himself or herself (Caldwell 1996, pp. 610-112). Particularly important are factors from the child's embedded socio-economic and cultural context: hygiene, the allocation of food in the family and living conditions of the household in which the child grows up. Poor living conditions may exacerbate an inadequate nutritional status whereas sufficient accessibility of food and health care may leave open the possibility of recovering slowed growth and counterbalance some of the detrimental effects of growth failure experienced earlier in life. The FAO identified Bangladesh in 1996 as a 'low-income food-deficit' country i.e. a country that has not enough food to feed its population and one that lacks the financial resources to pay for imports (USAID 1997, pp. 8-9).

Apart from poverty (particularly at the micro level), an unequal allocation of food in the family at the expense of young girls is likely to reflect the low status of girls and women within Bangladeshi society. As stated by Ross (1996, p. 5) "by the time she reaches puberty a Bangladeshi woman has already experienced a lifetime of discrimination compared to males". Blanchet (1984; 1996) describes several practices illustrating the lesser value of girls in Bangladesh: the *dai* (traditional birth attendant or midwife; Blanchet 1996, pp. 50-51; Carr et al. 1997, p. 222) cutting the cord of a boy nine fingers from the umbilicus but that of a girl only seven (1996, pp. 50-51); the *dai* who delivers a boy receives twice as much as one who delivers a girl (Blanchet

1984, p. 108; Blanchet 1996, p. 51); and the *azan* (an exclamation of joy after birth by the father or in his absence another man of the family to thank Allah) is louder, longer or different (for instance twice instead of once; in both ears in instead of one) for boys than for girls (Blanchet 1984, p. 120). Blanchet (1996, p. 50) notes furthermore that "the birth of a boy is always greeted with joy", whereas "the birth of a girl is welcomed when it is a first child (the first fruit which announces the fertility of the 'plant'), or when there are already boys and no girl in the family. Otherwise, it is often received with resentment". Later in life discrimination continues in various domains of life. For instance, between 1992 and 1997 Bangladeshi women's wages in manufacturing were 50 per cent that of men's wages (Population Reference Bureau 2002).

Son-preference is related to the fact that the Bangladeshi society is patrilineal and that post-marital residence is largely patrilocal. The importance of having at least one son is rooted in the perceptions of the male as the bread-winner and sole source of social support for parents in old age (Mukhopadhyay and Savithri 1998, p. 30). Girls are born to be given in marriage, which is commonly accompanied by a *dowry* (the transfer of money or valuables from the family of the bride to the groom and his family) - despite its illegal nature - and consequently may impoverish the family[14]. In the words of Blanchet (1996, p. 50) "boys represent wealth, but girls are seen as a cumbersome responsibility".

Although girls survive in greater numbers than infant boys almost everywhere, in a few countries, including Bangladesh, gender discrimination and neglect outweigh girls' biological advantage (Population Reference Bureau 2002). Although at a first glance living conditions seem to be alike for all members of the household, intra-household customs may result in different feeding patterns, care-giving and health-seeking behaviour of parents towards their children, at the expense of girls (Chen et al. 1981; WHO 2003, p. 15). Examples are girls eating after having served all other family members, the belief that girls have less nutritional requirements[15], girls' diets being restricted for fear that they 'grow too rapidly', food restrictions for girls on specific items (WHO 2003, p. 15), and more girls being abandoned or given up for adoption than boys (Blanchet 1996, p. 52). A recent study undertaken in 8 districts in Bangladesh revealed that 54 per cent of adolescent girls' brother(s) were given more food because of seniority or other (not specified) reasons, and that the diet of girls was more likely to be low in protein as compared to the male family members (Akther et al. 1999). Ramifications may be gender differentials in nutritional status and mortality from illness, as illustrated by several studies conducted in rural Bangladesh (D'Souza and Chen 1980; Chen et al. 1981; Bhuiya et al. 1988; Razzaque 1989; Bairagi and Chowdhury 1994). During the 1974-1975 famine infant mortality was higher among girls than among boys (Razzaque 1989). Under-five girls faced risks of mortality from measles that were twice as high as those for similar-aged boys (Bhuiya et al. 1988).

[14] The opposite system of dowry is 'joutuk', the brideprice paid by the groom's family to the bride's. In rural Bangladesh the norm of brideprice has shifted to that of dowry in the 1960s over a time span of less than one generation. As compared to brideprice, which has a more voluntary nature, dowry demands are more harsh and substantial (Amin and Cain 1997, pp. 290-293).

[15] The amount of extra nutrients required depends on the rate of growth, degree of physical maturation or body composition, activity level and sex. Boys generally have higher energy requirements than girls do due to their larger proportion of lean body mass to adipose tissue and this differences has implications for the nutritional needs of adolescent boys and girls (WHO 2003, p. 11).

There are indications that discrimination against girls is negligible in small families but much higher in families with more than two girls (Ross 1996, p. 5). Muhuri and Preston (1991, cited by Caldwell 1996, p. 612) pointed out that girls growing up in rural Bangladesh without older sisters had only slightly enhanced mortality as compared to their brothers, while those with elder sisters were prone to almost double infant mortality. Similarly, in rural India, it was found that both boys and girls who were born after multiple same-sex siblings experienced poor outcomes (with regard to nutritional status and immunisation), that preference for sons exists and that boys who are born after multiple daughters have the best possible outcomes (Pande 2003, pp. 395-418). However, other recent studies do not show such a sex-selective care-giving behaviour of parents towards their children in Bangladesh or a gender-bias regarding food allocation in India (WHO 2003, p. 19). The possible recent shift in Bangladesh is also illustrated by the number of deaths under age 1 per 1000 live births in the period 1995-2000 which amounted to 79 for girls and 78 for boys (Population Reference Bureau 2002).

2.4 Adolescence: reaching menarche and spermarche

After having survived infancy and childhood the child enters the precarious stage of adolescence, which carries a particular importance to the reproductive health career. The definition of 'adolescents' reproductive health' should basically not differ from the overall definition of reproductive health. However, because of their age, and in particular the developmental stage they are in, studying adolescents' reproductive health may necessitate a specific approach. Next, we elaborate upon the concept of adolescents' reproductive health, seen in light of the lifecourse perspective and the cultural context of Bangladesh (subsection 2.4.1). Thereafter the determinants of timing of menarche and spermarche are discussed, in part within largely malnourished populations (subsection 2.4.2). We close this section with a discussion of the social significance of these reproductive transitions in relation to the Bangladeshi cultural context (subsection 2.4.3).

2.4.1 Concept of adolescents' reproductive health in Bangladesh

Delimitation by age

'Adolescence' is defined as the period from 10 to 19 years (UNFPA 1998a, p. 1). Some studies, however, apply a narrow definition of 15 to 19 years, while a few studies include all 10 to 24-year-olds, hereby applying the term 'young people' in general (UNFPA 1998a, p. 1). From a demographic point of view, it seems as if the choice of a narrow definition of 15 to 19 years is closely related to the overall definition of 'reproductive years', generally identified as the period of 15 to 45 or 15 to 49 years for women in fertility- or reproductive health-related demographic and health studies and censuses. As noted by Becker (1993, p. 21) "for fertility statistics, the 15 to 19 year age group is used". The choice of a definition with a lower cut-off point of 15 years seems also related to the fact that in many countries childbearing among girls younger than 15 years is scarce. Moreover, for socio-cultural reasons questions dealing with fertility or reproduction may be addressed to *married* women only. This study is about adolescents' reproductive health in Bangladesh, a country where currently 48 per cent of the 15 to 19-year-old girls is married (Population

Reference Bureau 2000, p. 21). Historically, the mean age at first marriage has been low in Bangladesh: 12.3 years in 1975 and 14.8 years in 1989 among ever-married women (Islam and Mahmud 1995, p. 23). Given these statistics, one could argue that research on adolescents' reproductive health in Bangladesh should preferably apply the overall definition of adolescence, i.e. the period between years 10 and 19, thus including the youngest age group.

Classification according to physical, mental or social markers of development

Such a 'dogmatic' approach to the concept of adolescence, bounded by age-ranges, does not give enough credit to the complex and multi-dimensional character of this stage in life. Adolescence is generally identified as the period during which physical and social maturity take place. Transitions and processes, such as reaching menarche, developing close friendships, dealing with peer pressure, building an identity, becoming aware of one's sexuality, do not exactly begin or occur at the age of 10 and stop on the day of reaching one's twentieth birthday. To the contrary, as we will outline in the upcoming subsections 2.4.2 and 2.4.3, the timing and duration of these transitions and processes differ between populations and individuals. Although development processes (physical maturation, socialisation) are universal (albeit not the timing of transitions), the socio-cultural meaning attributed to processes and transitions differs between cultures. As stated by Jejeebhoy (1998, p. 1275) "variation in social and cultural settings between countries and biological differences concerning age of physical maturation render different connotations to the meaning of adolescence in different settings". In addition, following Ojeda et al. (1985, p. 4) cultural and socio-economic factors, in particular educational level and the opportunities to participate actively in the work force, may be decisive for the chronological delimitation of an age group rather than biological factors. A case in point is that the meaning of 'adolescence' for girls working in (garment) factories in urban settings is altering gradually because of the opportunities their work brings (saving money, postponing marriage, greater social freedom) (Amin et al. 1998, pp. 185-200; Population Council and ICRW 2000, pp. 24-26). Much may thus depend on adolescents' socio-cultural class or economic position. As noted by Monroy de Velasco (1985, p. 21) "the behaviour of adolescents in the basic areas of socialisation differs in accordance with the social class to which they belong".

Indicators of adolescents' reproductive health in this study

Given the great diversity among adolescents in terms of sex, gender, age, social and economic class, the concept of adolescents' reproductive health may need to be defined in view of a mixture of (physical, social, mental, economic) factors. In the case of adolescent girls for instance, not only menarche may mark the onset of adolescence but rather the changes that occur with regard to expected social behaviours arising from this event. Before we can relate such a notion on adolescence in Bangladesh to reproductive health, we recall that at the ICDP reproductive health was defined to encompass "a state of complete *physical*, *mental* and *social* well-being (…) in all matters relating to the reproductive system and to its functions and processes" (ICPD 1994 paragraph 7.2, p. 45). As noted in section 1.2, the Programme of Action (PoA) as adopted at the ICPD includes a broad range of topics associated with adolescents' reproductive health but does not provide *specific indicators* of this status.

In this study, we confine the concept of adolescents' reproductive health to two of the three components, i.e. physical and mental well-being in the reproductive domain. In order to arrive at an indicator of *physical* reproductive well-being in adolescence, a reference could be made to the 'Gold Standard' of adolescent maturity: the method developed by Tanner in 1962 and still in use, which is based on stages of breast development, testicular size and pubic hair (Soekarjo 2003, p. 19). For obvious reasons this method is not suitable for fieldwork studies (WHO 1995, p. 267). However, in a study undertaken in rural Indonesia, self-reported age at menarche and (first) nocturnal ejaculation (spermarche) showed to be valid, as well as culturally acceptable and appropriate milestones for adolescent maturity rating (Soekarjo et al. 2003, pp. 27-39). With respect to *mental* reproductive well-being in adolescence, a link can be made to what is called 'developmental readiness', which is key in Erikson's theory on psychosocial development (see subsection 2.2.2). In this study we analyse knowledge and perceptions (including emotions) about reproductive transitions and developmental processes that are typical of the adolescent stage. If 'prepared', the reaching of menarche and spermarche is less likely to be experienced in a state of ignorance or anxiety. However, reproductive knowledge is also required in order to be 'prepared' for future reproductive health events (notably childbirth) and for maintaining reproductive health status in adulthood.

In the next two subsections 2.4.2 and 2.4.3 we subsequently discuss the *timing* of menarche and spermarche among adolescents and the social connotations of these reproductive transitions within Bangladeshi society. Such a contextual sketch provides insight into the conditions and circumstances that shape Bangladeshi adolescents' knowledge and perceptions about reproductive health.

2.4.2 Timing of menarche and spermarche

Menarche

For girls, the adolescent stage is announced by the onset of menarche, the initiation of uterine bleeding. In most countries, particularly developed countries, the average age at menarche has gradually decreased in the past century due to improved nutritional conditions, better health care and improved environmental conditions. Throughout time, the reported ages of menarche differ considerably worldwide. Becker (1993, pp. 23-31), drawing largely on data published by Eveleth and Tanner in 1976, includes an extensive list of (median or mean) ages at menarche for various populations by world region, which originate from studies conducted between the 1950s and the 1980s. The average age at menarche ranges from about 12.5-13.0 years in contemporary Western countries (Riley et al. 1993, p. 50) to more than 15 years in developing countries. Cross-cultural trend studies show that age at menarche generally declines over time at a pace of two months per decade, although the decline is slacking or even coming to a halt in some developed nations (Becker 1993, p. 31). Other studies mention a secular decline at a pace of three to four months per decade (Rich-Edwards 2002, p. 25). Becker (1993, p. 31) notes that "it seems clear that a biological minimum age at menarche exists and the distributions of age at menarche in some developed countries are pushing up against this limit".

Studies on menarche in Bangladesh, a country where malnutrition is highly prevalent - especially among children and adolescents - are not consistent about the average age at which the menstrual cycle commences. Moreover they do not unambiguously point to a decline or delay of menarche, let alone the extent of it. This inconsistency may in part be related to the fact that *censored* cases (i.e. those girls who have not reached menarche at the time of data collection) are generally not taken into account. In 1976 median ages for Muslims and Hindus were respectively 15.8 and 16.0 years (Chowdhury et al. 1977). These high median ages are comparable with those found among economically less developed societies such as the New Guinea tribes (ranging from 15.5 and 18.4 years), Nepalis (ranging from 15.2 to 17.0 years[16]), rural Rwandans (ranging from 16.5 and 17.0 years) and the nomadic Dobe !Kung in South Africa (16.6 years) (Becker 1993, p. 30) but are also comparable to estimates for nineteenth-century European populations. Historical data show that in Western societies a decline in age at menarche of about 3 years has taken place since the end of 1800.

In Matlab, the average age at menarche of Muslim girls increased from 12.9 years in 1961 to 17.4 years in 1977 (Chowdhury et al. 1977). This increase was ascribed to worsening nutritional conditions because of the war in 1971 and famine in 1974 (Becker 1993, p. 31). In the eighties, the adolescent growth spurt was still considerably delayed, extended and less intense in girls from Matlab as compared to a sample of British girls (Riley 1987). More specifically, age at menarche was delayed by about 3 years in Bangladesh (15.8 years in Matlab) as compared to Western populations (12.5 years). Riley suggests that this is due to chronic malnutrition *in childhood*. Data from the 1996 Matlab Health and Socio-economic Survey yield an average age at menarche for 20 to 24-year-old women of 14.6 years (own calculation). A study by Akther et al. (1999, p. 5) showed that of 1,000 adolescent girls, 92 per cent had reached menarche by the age of 14 years. However, in a study by Chowdhury et al. (2000, pp. 249-256) conducted in another rural Bangladeshi area (Rupganj *thana*[17], Narayanganj District), a mean age at menarche of 13.0 years was determined by retrospective recall.

Determinants of timing of menarche

Studies on determinants of menarche are generally based on the two types of assumptions, which also reflect the discussion on *nature* versus *nurture*. Firstly, it is hypothesised that there is a potential age of reaching sexual maturity, which is 'genetically programmed', i.e. sexual maturity is bound to be reached at a certain age or after having reached a certain stage of physical development that follows a genetically-based timetable of maturation. Hormones mediate this underlying process but how endocrinal factors determine the onset of menarche is poorly understood (Gray 1993, p. 220). The underlying hormonal system entails among others small quantities of ovarian steroids, (an increasing level of) ovarian oestrogen in early puberty, which in turn triggers the release of a lutenizing hormone as a consequence of which ovulation is initiated (Gray 1993, p. 220).

A late menarche may 'run in the family'. There is some evidence of genetic predisposition on timing of menarche, which is among others grounded on the finding that age at menarche of mothers and their daughters is positively correlated (Gray

[16] These age boundaries reflect mean instead of median ages at menarche.

[17] Regional unit, comparable with a sub-district (Faveau 1994, p. 13).

1993, p. 220). However, the predictive power of age at menarche of a girl's mother is small (Graber et al. 1995). Genetic factors probably account for approximately 10 to 15 per cent of the observed variation in age at menarche (Gray 1993, p. 220). Another way of examining the role of genetic inheritance in conjunction with 'nurture' factors on the reproductive maturation process is by conducting studies on twins. There is a strong association between age at menarche of monozygotic twins (who share identical genetic material whereas they live distinct lives) when compared to the association for dizygotic twins (Gray 1993, p. 220). In a classical study on twins the genetic contribution to the variance in age at menarche was estimated to be 45 per cent, with the majority (37 per cent) being due to dominant genetic effects (Snieder et al. 1998, pp. 1875-1880). At the group level, the role played by heredity may be reflected in associations between timing of menarche and ethnic group: Hispanic, Asian-Pacific Island and African-American girls are for instance more likely to experience early menarche than non-Hispanic white girls (Koprowski et al. 1999). Accordingly, Richardson et al. (1983) found that nutritional components cannot be fully held accountable for differences in timing of menarche among four ethnic groups in South African girls.

Secondly, it is hypothesised that other factors than genetic heredity impact the timing of menarche. It is widely recognised that nutritional status is one of the most important non-genetic determinants of menarche (Riley et al. 1993, p. 50). Menarche typically starts about one year after peak growth velocity (WHO 2003, p. 12) and better nourished girls reach menarche earlier than undernourished girls (WHO 2003, p. 15). Nutritional status, indexed by weight, height and adiposity, has been associated with menarche but the determinants of pre-pubertal growth (for instance diet, hormones, infections) which affect timing of menarche are not known, "nor is there agreement regarding the relevant 'critical period' for determining menarche" (Rich-Edwards 2002, p. 28).

Central to the so-called 'critical weight hypothesis' is the assumption that irrespective of age, menarche occurs only after an adolescent girl has reached a certain 'critical weight' (Frisch and Revelle 1969; 1971). However, the evidence presented in support of this hypothesis appeared to be weak (Trussell 1980). Rao et al. (1998, pp. 619-628) tested the critical weight hypothesis in Indian girls in relation to socio-economic class and found that at the group level the mean weight at menarche was around 38.0 kilograms in both socio-economic classes, irrespective of age at this event. Kurdzielewicz et al. (1999, pp. 354-358) found a weight of 48.0 kilograms (and a length of 159.2 centimetres, resulting in a BMI of 18.9) to correspond with a mean age at menarche of 13.1 years. Also the distribution of fat on the girl's body may play a role: girls with fat localised around their hips (pear shaped) may have an earlier menarche than girls with abdominal fat (apple shaped) (Napieralski and Devine 1998, p. 1). Levels of fat accumulation during childhood and adolescence relate to adequacy of diet, particularly diet rich in protein and calories, in relation to the amount of physical labour or (excessive) exercise (Koziel and Jankowska 2002, p. 268).

Apart from weight, other studies (Delgado et al. 1985; Linhares et al. 1986; Koprowski et al. 1999) also underline the impact of height (changes in bone growth) and/or mid-upper arm circumference on age at menarche. Koprowski et al. (1999) found that among a group of Southern California schoolgirls, tall girls (>148.6 centimetres) reached menarche earlier than short girls (<135.9 centimetres). A similar association was found between those with a high BMI (>20.7) versus those with a low BMI (<16.1). Also Chowdhury et al. (2000, pp. 249-256) found early menarche to be associated with better nutritional status, indicated by a significantly higher mean BMI and height among menstruating girls as compared to similar-aged non-menstruating girls. The findings indicate that instead of specifically weight or height only rather the combined effect of these two anthropometric measurements impacts the timing of menarche. Taller, heavier girls generally start menstruation earlier than shorter, lighter girls but both anthropometric indices and the distribution of body fat are also influenced by genetic inheritance (Napieralski and Devine 1998, p. 1). Whereas weight reflects current nutritional status, height can considered to be a reflection of nutritional status in the past. Okasa et al. (2001, pp. 68-78) note that age at menarche has been used as a *marker* of environmental conditions during childhood. The association between height and timing of menarche may be related to ovarian volume in childhood. Bridges et al. (1993, pp. 456-460) found that tall girls had significant greater ovarian volume, and concluded that growth hormone appears to influence ovarian growth.

It is assumed that foetal conditions, among others reflected in weight and size at birth, may influence the timing of menarche, although their relationship with reproductive maturation has not yet been completely established and not all studies support this hypothesis. In a study among Polish girls who reached menarche on average at the age of 12.7 years, it appeared that girls born with a low birth weight for gestational age (the cut-off value of the 10th percentile) were more likely to have experienced menarche by the age of 14 years as compared to their peers with a birth weight appropriate to gestational age (Koziel and Jankowska 2002, pp. 268-269). This finding corroborates the results obtained by Persson et al. (1999, pp. 747-755) who observed that onset of puberty and age at menarche occurred five months earlier among girls born small-for-gestational-age compared to girls born with normal body size for gestational age.

At first glance, such a finding is counter-intuitive in view of the fact that a) birth weight is positively associated with subsequent fatness (see for instance the overview by Power and Parsons 2002, pp. 310-311); and b) weight in childhood and pre-adolescence is associated with early onset of menarche (see overview above). However, in line with Barker's programming hypothesis, disturbances in foetal growth may advance the onset of puberty and consequently earlier menarche due to patterns of early childhood growth[18]. Thus the impact of a smaller size at birth may be compensated by a higher postnatal weight gain (Cheung et al. 2002, p. 335). Similarly, Silva et al. (2003) initially found a similar counter-intuitive association between birth weight and menarche, but after controlling for growth in infancy (up to two years) the effect reversed whereby girls who were heavy at birth reached menarche earlier than others with similar infant growth (Silva et al. 2003, pp. 405-412). The authors consequently conclude that timing of menarche may be set in utero or early in life but be modified by changes in body size and composition in childhood.

However, as noted by Cole (2000, p. 323) "the timing of menarche is probably set near the time of birth, but the mechanisms involved are unclear". A certain amount of

[18] More specifically, the programmed patterns of gonadotropin release established during antenatal ontogenesis (Persson et al. 1999; Koziel and Jankowska 2002, p. 271; Rich-Edwards 2002, p. 27).

caution is indeed called for because in research by Lumey and Stein (1997, p. 1964) on the basis of the earlier-mentioned *Dutch Famine Birth Cohort* no detectable effect was found between in utero famine exposure and age at menarche later. Also, in Guatemala daughters of mothers who received energy- and protein-rich supplementation during pregnancy did not significantly have a lower age at menarche than daughters of mothers who received a low-energy, no protein supplement (Khan et al. 1995, p. 1092). Today there are only a handful of reports that hint at fetal determinants of age at menarche (Rich-Edwards 2002, p. 27). Examples from animal studies do however point in the direction of some sort of ‘defence mechanisms’ set in utero. In Bateson’s view, predicting the kind of nutritional environment (adequate or poor) a girl will grow up in may be set in utero, a line of thinking which corroborates the Barker hypothesis. However, rather than use the term ‘programming’, as was en vogue with the Barker group, this process of ‘maternal nutritional forecasting’ is referred to as ‘induction’ in developmental biology (Bateson 2001, p. 929). Based on animal studies, the developmental rule among adolescent girls would be: “if conditions are good, become sexually mature early, but if conditions are poor, delay maturity” (Bateson 2001, p. 929).

Apart from genetic inheritance and contemporary and (very) early life nutritional status, the timing of menarche is often studied in relation to factors that are mainly behavioural in character (life style) or reflect a myriad of socio-economic conditions. In addition, given the knowledge that menarche and the menstrual cycle are triggered by hormones, the role of psychological stress on the menstrual cycle is recently being studied but not yet understood (Sanders and Bruce 1999). Evidence for this line of thinking involves among others data on delayed menarche in (adolescent) girls in wars (for instance World War II, Srebrenica) which could not be attributed to nutritional deprivation (Rich-Edwards 2002, p. 29). Other (correlational) studies on the determinants of menarche include *socio-cultural, economic* or *environmental* factors. Graham et al. (1999, pp. 257-267) found that year of birth, literacy status, county of residence, amount of physical labour, general health status, pesticide exposure before menarche, and drinking water source had led to the decrease in mean age at menarche from 16.5 to 13.7 over an approximate time interval of 40 years in two rural counties of the Anhui Province in China. Although the study on such *indirect* determinants of menarche is informative in itself, it should in our view be kept in mind that - with the exception of a few factors such as year at birth and pesticide exposure, which may impact levels of hormones related to reproductive functioning directly - all determinants are manifested *through* nutritional status.

In general, athletes or girls that undertake strenuous exercise reach menarche at a later age compared to non-athletes, which can be attributed to lower body weight and lower proportion of body fat in athletes, although this later age at menarche may also be due to heredity (Riley et al. 1993, p. 50; Napieralski and Devine 1998, p. 2). Riley et al. (1993, p. 51) discuss the suggestion that high daily energy expenditure activities such as carrying wood and water and harvesting, which are often done by adolescent girls in developing countries, can be related to later onset. However, they do not consider this likely. Despite the considerable energy required by these activities, they do not place the same demands on the cardiovascular and muscular skeletal systems as the athletic activities (Riley et al. 1993, p. 51).

In sum, from the above we learned that age at menarche is influenced by multiple determinants that partly (mainly the 'nurture part') vary between individuals and populations. Figure 2.4 (page 40) summarises the most important factors identified in this subsection as possible determinants of timing of menarche. Prenatal factors considered are maternal characteristics (mother's age at menarche and her stature); postnatal factors discussed are nutritional status in (early) childhood and in adolescence, as well as those indicated by anthropometry.

Following the terminology adopted by Davis and Blake in 1956 and Bongaarts and Potter (1983), we may classify some determinants of menarche as *proximate* in contrast to *indirect* determinants. The principle characteristic of a proximate determinant is that it influences the outcome variable directly, meaning that if a proximate determinant changes, the outcome variable changes as well (assuming that the other proximate determinants remain constant), whereas this is not necessarily the case for indirect determinants (Bongaarts and Potter 1983, p. 1). Given the elaboration as presented in this subsection, it could be argued that nutritional status in pre-adolescence, indicated particularly by weight and, possibly to a lesser extent, height as well, may be considered as a proximate determinant of timing of menarche.

Spermarche

For boys from a biological perspective, the onset of the adolescent stage, as well as their reproductive career, commences with spermarche, the first release of spermatozoa (Hirsch et al. 1979, pp. 289-298). We would like to discuss timing of spermarche in a similar manner as we did for timing of menarche, whereby proximate determinants are distinguished from indirect determinants. However, data on spermarche are scarce particularly in developing countries (WHO 1995, p. 267). The study on spermarche has been hampered by social and ethical considerations (Hirsch et al. 1979, pp. 289-298). In studies on menarche and menstruation the main interest lies in their timing and periodic nature. The menstrual cycle follows a monthly pattern, directed by hormones, and is beyond the 'control' of the girl or woman in question. In contrast to menarche and menstruation, that are considered 'natural biological' events although often imbued with quite specific cultural meanings, spermarche is associated with masturbation (wet dreams, nocturnal emissions, 'night pressure'), and generally tabooed, particularly in Bangladesh as will be discussed in subsection 2.4.3.

Among adolescent boys in Indonesia the median age at spermarche (self-reported nocturnal ejaculation) was 12 years (Soekarjo et al. 2003, pp. 27-39). Among Israeli schoolboys the rate of spermaturia was 38 per cent at age 12 and 69 per cent at age 13 (Hirsch et al. 1985, pp. 35-39). In an earlier study among Israeli schoolboys, the median age of spermarche was estimated 14.5 years (Hirsch et al. 1979, pp. 289-298). The latter findings are in accordance with the median age of spermarche at 14 years among American boys in 1988 (TAGI 1997, pp. 1-2). Few studies have been carried out about the short- or long-term effects of malnutrition on the maturation process of boys and men. The effects of malnutrition and, in its ultimate form starvation, in (adult) males are loss of libido and sperm quality, i.e. the decrease in prostate fluid, sperm count, loss of sperm mobility, and eventually the cessation of sperm production (Frisch 1993, p. 138). Persson et al. (1999, pp. 747-755) studied the hypothesis that perinatal factors (being born after pre-eclampsia or born prematurely), along with being born small, large, short or tall for gestational age, influence the onset of puberty. They found that age at puberty for boys did not differ between 'normal' boys and boys affected by perinatal factors; boys who were small at birth and short for gestational age were however on average four centimetres shorter than 'normal' boys, whereas those born tall for gestational age were on average three centimetres taller than 'normal' boys at the onset of puberty. It is plausible to assume that, as is the case with girls, childhood malnutrition may also delay the growth spurt and pace of sexual maturation in boys, and, that pending different nutritional regimes the mean ages at which reproductive transitions take place are subject to change over time as well.

2.4.3 Social significance of reproductive transitions in adolescence

Having discussed the merely *physical* pathways underlying timing of menarche, this subsection addresses the *socio-cultural connotations* (or perceptions) of menarche and spermarche. Particularly in late childhood and adolescence the worlds of boys and girls in Bangladesh become increasingly segregated. Girls participate in child care, food preparation and other household tasks, and sons work for wages from a young age (Mukhopadhyay and Savithri 1998, p. 26). Being responsible for their family's contact with the larger community, the focus or 'world' of a boy becomes larger.

When girls grow up, their lives are increasingly confined to their family compound (and later to her family-in-law's). A symbolic aspect of this confinement is that girls are sometimes named after pet birds, whereas boys are given names connoting qualities of courage and leadership (Fauveau 1994, p. 276). As illustrated by the story of Monowara and Beauty (Chapter 1), girls enrolled in our study often had names or nicknames referring to their appearance such as *Beauty*, *Lovely*, *Swapna* (dream), whereas most boys bore names of typical Muslim leaders such as *Mohammed* and *Hossein*.

While studying the *meaning* of adolescent transitions, a reference should be made to the work of Aziz and Maloney (1985) entitled '*Life stages, gender and fertility in Bangladesh*'. We have drawn heavily upon their work, as well as on writings of Blanchet (1984; 1996), who is quite critical about Aziz and Maloney's work: their fieldwork is considered relatively outdated, the words used by the authors seem to "belong to a literary tradition and are most likely to be used by educated Bangladeshi", and in reality the stages of adolescence in Bangladesh would not be that fixed and may be much more complex and vary by for instance socio-economic group or region (Blanchet 1996, pp. 45-46). However, to our knowledge, the work of Aziz and Maloney is the only study which follows a *lifecourse* perspective, whereby also the socio-cultural meaning of the *adolescent* stage is addressed, and which is undertaken in *Matlab*. Building further on the eight stages of life as defined by Erikson, Aziz and Maloney (1985) distinguish three periods in adolescence that are each characterised by specific behaviours considered appropriate for that particular stage (Figure 2.5): the pre-adolescence stage (*kaisorer prarambha*), especially for girls of 11 to 12 years, early adolescence (*kaisor*) from 12 to 15 years, and late adolescence or youth (*nabajauban*).

Figure 2.4: Determinants of menarche as identified on the basis of literature review

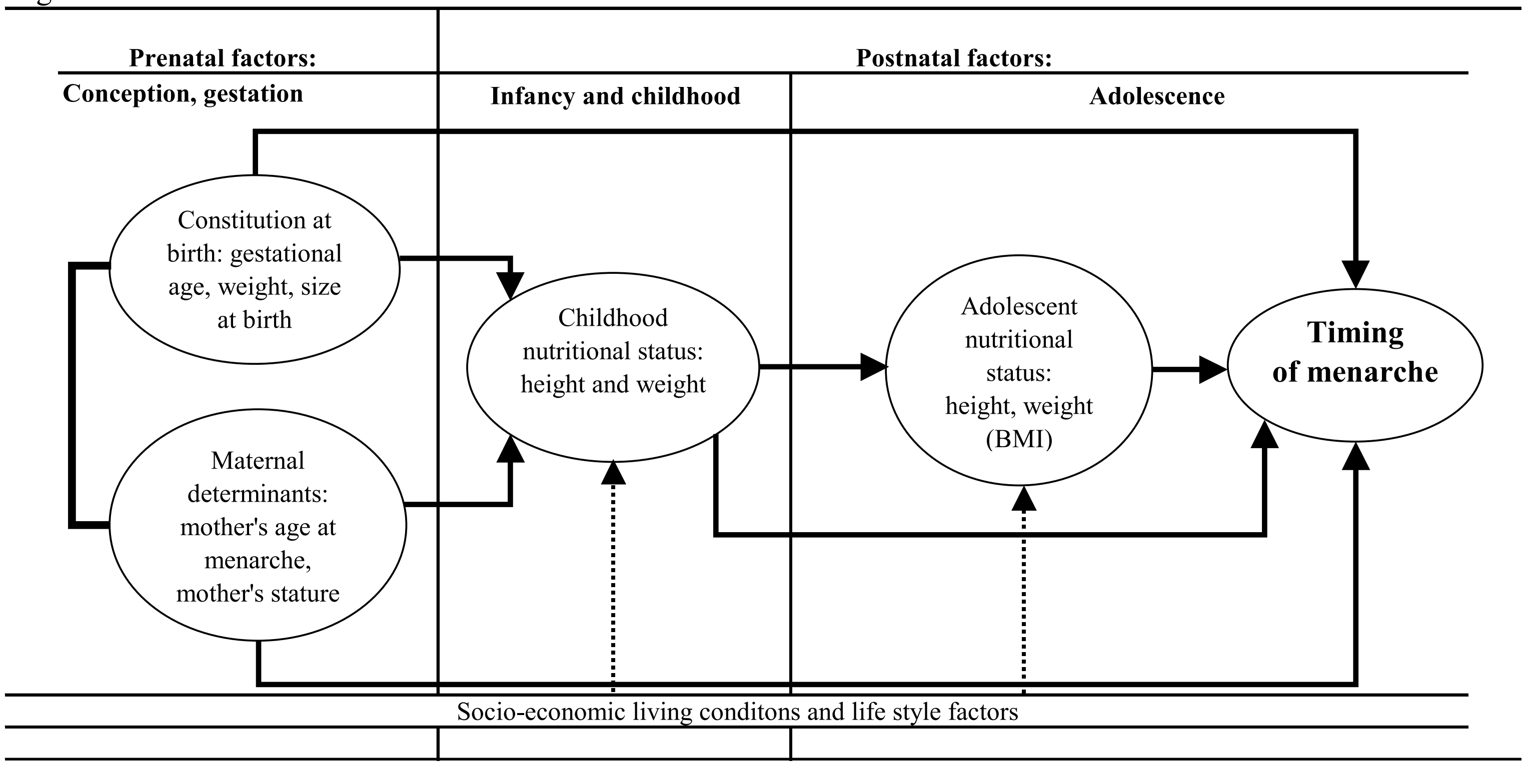

Figure 2.5: Life stages in Matlab, Bangladesh, between birth and age 20

		Adolescence		
Sisukal	**Balyakal**	**Kaisorer prarambha**	**Kaisor**	**Nabajaubon**
Infancy and early childhood	Late childhood 'school or work age'	Pre-adolescence	Early adolescence	Late adolescence
0-5 yrs	6-10 yrs	11-12 yrs	13-15 yrs	16-20 yrs

Source (slightly adapted): Aziz and Maloney (1985) and Blanchet (1996)

The adolescent sub-stages are preceded by the stage of *shisukal* (up to 5 years of age) and *balyakal* (6 to 10 years). A *shishy* child is a child who "does not understand". The concept of *shishy* does not yet distinguish gender. However, during the subsequent stages boys and girls increasingly learn the gender-specific roles that they are expected to play and consequently are addressed according to stage and gender: *balok, balika* and *kishor*, *kishori* (Blanchet 1996, p. 38). By the age of five, boys are fully aware of their specific gender roles and their hierarchical and oppositional characteristics (Kahn et al. 2003, p. 8). Although not explicitly studied, this probably applies to girls of this age as well.

Despite the aforementioned age boundaries, indicators of physiological development and transitions as well as the hereby imposed normative modes of conduct - which seem to be stronger for girls as compared to boys as we briefly describe below - are decisive for the distinction of the respective stages. A girl is for instance in the pre-adolescent age when her growth spurt begins, and certainly by the time she reaches menarche. Pre-adolescence in boys is celebrated with circumcision. A boy is identified to be in early adolescence at the time of his growth spurt, the production of semen, the growth of a moustache and the breaking of voice. As noted by Blanchet there is "great flexibility and tolerance in accepting the pace in which children develop" (1996, p. 46) and "Bengali culture and language recognise life-stages but years of age are not counted with any precision" (1996, p. 41).

Pre-adolescence or kaisorer prarambha

The period of *kaisorer prarambha* is distinguished more for girls than for boys because of the importance attached to girls' behaviour during adolescence which directly impinge on the reputation of herself and her family. A girl in the pre-adolescence period is asked to learn to observe *purdah*, an institutionalised socio-cultural mode of conduct, perpetuated by religion (Ross 1996, p. 33). The norms imposed by *purdah* enforce a high standard of female modesty, dictates propriety in deed and thought, restricts mobility, limits autonomy and, makes women dependent (Ross 1996, p. 33). In practice, observing *purdah* means that a girl should attend to domestic cores, cannot go outside alone unless accompanied by an older woman, is not supposed to speak loudly but rather she should talk soft, and move politely and is expected to cover her head with a shawl (*ghomta*) in the presence of older men.

Walking to school is done in a group of peers or in the company of older brothers or sisters. Parents are afraid that if a girl works in the field, sexual mishaps (*aghatan*) will occur. Girls are not supposed to be hugged by their father after the age of 8 or 10 years, whereas boys are not to be hugged by their mother after the age of 10 or 12 years. It seems that Bangladeshi girls are expected to learn at a very early age (before the end of childhood) the gender schemas, i.e. how to behave as a woman as defined in Bangladeshi society.

In the pre-adolescent stage Muslim boys are circumcised, which is crucial to the embodiment of *dhormo*[19] (Blanchet 1996, p. 56). The age at which this happens can vary considerably, anywhere between 4 and 10 years (Blanchet 1996, p. 56), but is certainly carried out well before boys are believed to reach sexual maturity. The circumcision procedure is in many ways comparable to a wedding ceremony and accompanied by special rituals and dietary precautions. After this *rite of passage* a party is thrown in honour of the - elaborately dressed up - boy in order to celebrate his new status and, moreover, to make a public acknowledgement of the transition. Illustrative for a boy's transition to adulthood is that "a circumcised penis is given the name of an adult penis, even if the boy has not yet reached puberty" (Blanchet 1996, p. 56). The few rules or expectations for boys in this same period are learning to carry out farming tasks or other work in order to contribute to the family income and fulfilling some religious duties like for instance praying five times a day (*namaz*). Also, they are not expected to talk to adolescent girls alone and to look at them with 'improper' (i.e. a sexual or romantic) intention (Begum 2000).

Early adolescence or kaisor

The period of *kaisor* is most relevant to our adolescent study population. A Bangladeshi girl is in the period of early adolescence at least by the time she begins her growth spurt and certainly by the time she reaches menarche. A Muslim girl who has not yet reached menarche is called *nabalika*; a girl who has experienced this event is called *sabalika*. A Hindu girl in the latter stage is called *upajukta*, which literally means a girl who has become fit for coitus. Unlike India, in Bangladesh there is no public ceremony for girls reaching maturity (Aziz and Maloney 1985, p. 13). In general, in Bangladesh there are not many rituals of passage between stages as compared with other cultures (Aziz and Maloney 1985, p. 12).

A positive connotation of menarche is the term *phul phuteche* (Begum 2000). *Phul* means both flower as well as placenta (Blanchet 1984, p. 85). A woman's reproductive system is referred to as *gach*, or tree (Blanchet 1984, p. 95). Often however, menarche and menstruation in general are called *shorir kharap*, meaning impure and 'unclean', although these words carry connotations of indisposition or sickness. Menstruation in general (*mashik*) is considered shameful *(lozzajanak bepar*) (Begum 2000) because the blood is regarded as "the greatest of all pollutions" (Blanchet 1984, p. 33). Beliefs about the polluting nature of menstruation and associated taboos are also described for other societies, for instance India (Garg et al. 2001; Hutter et al. 2002). Common statements in India during menstruation are for instance "I have become untouchable" and "I am *mahar* (I am sitting apart)" (Ibid.

[19] 'Dhormo' is the right action according to the stage of life (Aziz and Maloney 1985, p. 7) or, more specific, a by god-ordained life path or religion and relates closely to one's 'jati', which is based upon one's inherited religious or occupational group, and gender (Blanchet 1996, p. 33).

2001, p. 19). In India and Bangladesh, menstruation is associated with taboos and accompanied by restrictions on work, food, bathing and the strongest of all, avoidance of sexual intercourse (Garg et al. 2001, p. 20). In Bangladesh it is expected that women and postmenarcheal adolescent girls do not enter the cow shed, kitchen, fields, or visit other houses and particularly sick persons (as a menstruating woman's touch may be harmful to the patient) and later in their lives, to abstain from sex and prayers during menstruation (Aziz and Maloney 1985, p. 149). It is commonly believed that a woman who does have sex while menstruating will contract a sexual disease (*maulavi kabiraj*) (Begum 2000). Also an irregular menstrual cycle (*mashik animito*) is associated with sexual intercourse during menstruation (Begum 2000).

For Bangladeshi girls, menarche is both an important event in their lives as well as a very private matter, generally viewed in a negative light. As in India, mothers seldom talk to their daughters about menstruation (Ross et al. 1996, p. 32). In a study of Akther et al. (1999, p. 5) undertaken in Bangladesh, only eight per cent of the girls was informed about menstruation by their mother. The silence surrounding menarche may be such that "the reason for the bleeding is not even disclosed" (Garg et al. 2001, p. 20), assuming that mothers *do* know about its physical origin. When a girl reaches menarche, the mother generally avoids any explanation or hides her shame or ignorance by using symbolic phrases like "your son is born" (Blanchet 1984, pp. 38-39). Regarding sexuality, 'innocence' is expected of adolescent girls and guilt and punishment are consequences for not observing the role that accords with the expected state of 'understanding', i.e. what it is they are expected to know as morally good and to practise it according to their life's path and *dhormo* in life (Blanchet 1996, pp. 47-48). It closely relates to the concept of *jati*, i.e. one's species, inherited religious or occupational group, or gender (Blanchet 1996, p. 33).

Research by Nahar et al. (2000, p. 1) among 4,000 10 to 19-year-old adolescent boys and girls from urban and rural areas in Bangladesh revealed that respectively 50 and 68 per cent of the boys girls knew about important physical changes that adolescents undergo. Only 34 per cent of the girls knew about menstruation before they reached menarche, as a result of which the experience was described as "a mental trauma" (Nahar et al. 2000, p. 1). A study by Akther et al. (1999, p. 5) found that 52 per cent of the girls shared similar experiences. Nearly 65 per cent of the girls enrolled in that study reported menstrual problems such as pain in the abdomen and back as well as weakness (Akther et al 1999, p. 5). After menarche, girls are informed about how to deal with menstruation and about the accompanying customs by their elder sisters, sisters-in-law or grandmothers; often, however, such information was found to be incomplete (Nahar et al. 2000, p. 1).

Although menarche may not be accompanied by special public *rites* it does induce a major transition in the young girl's life, as she is now considered to be marriageable. Illustrative in this respect is a saying from Bengali literature emphasising a girl's state of physical development in relation to marriage and *dowry*: "budding breasts in *kaisor* stage are worth one *crore*[20]" and "pomegranates, in late adolescence, are worth one *lakh*" (Aziz 1981, p. 51). Another case in point is that in rural Bangladesh, like many other rural societies, comparisons are made between stages of sexual development and the agricultural cycle: adolescent girls are, pending their physical development,

[20] A crore is ten million taka (the Bangladeshi currency); a lakh is one hundred thousand taka.

referred to as *auisya* or *amuinya,* a reference to paddy planted at the same time but the first type is ready to be harvested after 3 months whereas the latter takes 5 months to ripen (Aziz 1981).

For boys the production of semen seems to be an important indicator of the stage of development: before and after this event they are called either *nabalak* or *sabalak* respectively (which literally means 'he who has semen', but which is generally based on the appearance of secondary sexual characteristics). Similar to menstrual blood, semen is regarded as polluting when linked to masturbation. From an Islamic point of view masturbation is seen as a waste of semen as it does not lead to reproduction. In order to prevent boys from practising it, they are told that masturbation is likely to make the semen thin and less effective and to cause a series of harmful 'impairments' such as gonorrhoea, impotency, early ejaculation, infertility or deformed children later in life, and a general loss of health, charm and happiness (Aziz and Maloney 1985; Khan et al. 2003, p. 15). Adolescent boys from Dhaka associated semen to blood, whereby one drop of semen was considered the equivalent of 70 drops of blood, as a consequence of which masturbation is believed to seriously weaken the body and nocturnal emission is seen as a disease for which medicine is needed (Khan et al. 2003, pp. 18-20). Research among adult men in Matlab also revealed that masturbation and nocturnal omission were considered sexual problems for which treatment was sought (Rahman et al. 1997).

Other perceptions were that men have a limited and predetermined quantity of semen, which can be replenished by eating a large quantity of food but this process of replenishment is believed to become increasingly difficult as the man grows older (Fauveau 1994, p. 281). Only 29 per cent of the boys in some rural areas in Bangladesh did not know about 'wet dreams' prior to their onset (Nahar et al. 2000, p. 1). When boys received any information, generally from friends, it was incomplete, incorrect and associated with sickness. In a study by Alam (2002a, p. 1), semen emission, a source of *pourush* (male strength), was considered to be a major health problem among the respondents consisting of a mixed group of adolescent and adult males in a rural area of Bangladesh (not Matlab). Furthermore, the respondents were indifferent, unclear and uninformed about women's reproductive health concerns and problems or special needs of women during pregnancy, childbirth and the postpartum and lactation period.

In this stage (*kaisor*), the differences with the previous stage are clearly visible in codes governing dress and behaviours. A girl in the pre-adolescence period wears pants and a blouse (unless she attends Koran classes), but a girl in early adolescence is expected to wear a *shelwar kamiz* or a saree, with an *orna* (scarf) to protect her breasts and cover her head, as a sign of respect and modesty in front of senior males (Blanchet 1996, p. 57). If men see either body or hair, it is the girls who bear the shame. For girls, an important part of their social education is to learn attitudes such as extreme modesty and feelings of shame (*lojja*) or, in the words of Blanchet (1996, p. 57), "shame is not only a desirable quality, it is an essential attribute of virtuous women which must be instilled in girls before puberty". Boys do not yet need to take into account specific norms on clothing at this particular stage. Wearing of *lungi* is usually done at a later age. Boys at this stage - s*abalaks* - are however expected to perform adult duties, both in religious and societal terms, but in contrast to girls they can still swim, climb trees, play in the paddy fields, and are free to roam around wherever they want to. Girls are restricted to and around the house (Begum 2000).

Late adolescence or nabajauban

During *nabajauban* adolescents 'fine-tune' the schemas on gender roles that are valid and appropriate in this stage of life and in adulthood. The differences between schemas for boys and girls become increasingly apparent. *Nabajauban* is a precarious stage: parents should be careful and watch an unmarried girl, and gender role expectations become exaggerated in this period (Aziz and Maloney 1985). The vulnerable position of the adolescent girl is confirmed by studies on violent deaths (notably suicide and homicide) among women of reproductive age (Fauveau and Blanchet 1989; Ahmed et al. 2004). In Matlab during 1982-1998, 22 per cent of the death rates among 15 to 44 year old women were due to violence and related causes whereby the main factors contributing to suicide and homicide were beatings, torture and ill-treatment by family and family-in-laws (Ahmed et al. 2004). Illustrations of what is euphemistically called 'Eve-teasing' are reported daily in Bangladeshi newspapers[21] (Khan et al. 2003).

Modesty is particularly important in view of the adolescent girl's future life as a daughter-in-law. A newly-wed girl "becomes the household's most junior member, whose chief virtue is submission, learning how to do what will please the family and providing her worth through obedience, hard work, good temper and modest behaviour" (White 1992, p. 97). New wives are "new workers, whose labour, sexuality and fertility belong to the husband and his family" (White 1992, p. 98). As noted by Alam et al. (2000b, p. 5) "very young brides and grooms may not be able to cope emotionally with the heavy load of responsibilities in marital life". Viewed from the perspective of the bride, living in with the family-in-laws combined with the heavy daily workload - finally the mother-in-law has someone to take over the major part of the household chores - as well as adjusting to the new role of wife are exacting on the young bride. In order to avoid marital tension, endanger the stability of the marriage and consequently increase the risk of divorce, she most probably undergoes this period of life by observing silence.

2.5 Transition to adulthood: marriage and childbearing

Timing of menarche is not only an indicator of reproductive health status per se, it may also be crucial for the rest of the reproductive career. The *justification* of a study on timing of menarche is particularly reflected by the consequences of a small time gap between timing of menarche and subsequent reproductive health events. In this section, the context of adolescent marriage and fertility is briefly sketched against the importance of motherhood in Bangladesh (subsection 2.5.1). Malnourished girls typically experience menarche 'late' i.e. later than they probably would have had if

[21] One of the most dramatic forms of Eve-teasing is throwing (nitric or sulphuric) acid in the face, which causes the skin tissue to melt, often exposing the bones underneath the flesh and sometimes even dissolving the bones. The majority of these victims are women, and nearly half of them are adolescent girls below 18 years. They are attacked because they have spurned sexual advances of men, rejected a marriage proposal or because of family or land disputes, dowry demands or desire for revenge. Systematic data collection on this topic was started recently in 1999 by The Acid Survivors Foundation. In that year they documented 210 cases, but they believe that the number of actual cases is higher and increasing at an alarming rate (The Acid Survivors Foundation 2001).

they had been well nourished. Particularly for these girls the gap between menarche on the one hand and marriage, first pregnancy and childbearing on the other, may be small. Malnutrition and young gynaecological age are likely to increase the risks related with adolescent childbearing (subsection 2.5.2).

2.5.1 Adolescent marriage and fertility

Within the cultural setting of Bangladesh, menarche announces the start of the reproductive career and "readiness for marriage" (Riley et al. 1993, p. 52). Hence the relatively low - among the lowest in the world - mean ages at marriage among ever-married women in this country: 12.3 years in 1975 and 14.8 in 1989 (Islam and Mahmud 1995, p. 23). In 1984, legal restrictions on marital age were revised in the *Child Marriage Restraint Act*: the minimum legal age of marriage was set at 18 years for women and 21 years for men (Ross et al. 1996, p. 17). In Matlab, the mean age of marriage for women has been 18 years and above only since 1984, prior to which the average age at marriage among girls was consistently below the age of 18 years (Mostafa et al. 1996, p. 46).

Though well regulated in theory, in practice laws governing marriage are either "hardly known over the countryside" or "blatantly ignored because they are at such odds with social norms" (Ross et al. 1996, p. 18). As a consequence, the marriage is either unregistered or registered with overreported ages since it is believed to be a legitimate union in the eyes of the *samaj* or society (Blanchet 1996, pp. 43-44). In 1995, 42 per cent of the 15 to 19-year-old adolescent girls in Bangladesh was married (MWCA 1997, p. 17). In 2000, the average age at marriage in Matlab was 19.0 years for first-time brides (which is comparable to the 1995 national average of 19.9 years) and 26.3 for first-time grooms (ICDDR,B 2002a, p. 41; MWCA 1997, p. 17). There are indications that young people in Bangladesh are not in favour of such a large age gap between spouses (Haider et al. 1997). Differences in age at marriage may influence the power balance between the partners (UNFPA 2003, p. 16). In Bangladesh, girls and women have a smaller say in the marriage matchmaking process and also during the marriage they have a weaker negotiation position (Blanchet 1996, p. 57). Boys are generally informed about their upcoming wedding and may come "to view the bride" in advance, whereas girls are usually notified at a late stage and are "supposed to remain ignorant of and detached from the forthcoming marriage" (White 1992, pp. 99-100).

For a myriad of reasons the interval between age at menarche and age at marriage in Bangladesh is relatively small. Late age at menarche plays a role, but as important is the preference for early marriage, which can in part be attributed to the emphasis on *izzat* or honour (Mkuhopadhyay and Savithri 1998, p. 28). In Bangladesh, preservation of virginity until marriage is highly valued (Caldwell et al. 1998, p. 147) and early marriage ensures that "the girl does not stray sexually" (Mukhopadhyay and Savithri 1998, p. 48). In Bangladesh, "sex outside marriage occurs only seldom since premarital sex is looked upon harshly in the society" (Islam and Mahud 1995, p. 23). Prohibition of premarital sex encourages premenarcheal marriages or short intervals between menarche and marriage (Riley 1994, p. 86). A few studies reveal however that unmarried adolescents in Bangladesh are sexually active, though probably not on a large scale (Gazi et al. 1999; Gubhaju 2002; Alam 2002b). Other (related) reasons for early marriage in rural Bangladesh are the demand for (higher) dowry for older girls, poverty of the father, and criticism of the community about grown-up unmarried girls (Nessa 1997). There is a saying in Bangladesh that a women is old at the age of 20 years (‘*kurite buri*’) but that a man is still young at the age of 70 years (Begum 2000).

The process of matchmaking is highly sensitive, not only for the families involved but notably for the adolescents themselves, particularly the girl. Her *dowry* is influenced by personal traits such as appearance, complexion, and physical maturation. Nutritional status is also found to be associated with the age at marriage in the sense that relatively heavy girls marry at younger ages than their lighter counterparts, even when menarche status is controlled for (Riley 1994, pp. 94-97). Better nourished adolescent girls are viewed as more attractive, physically stronger and more matured as compared to undernourished girls (Riley 1994, p. 88). Not only the greater physical attraction per se, but also the fact that a good nutritional status reflects a relatively good socio-economic status may enable families with adequate resources to arrange an early marriage for their daughters (Riley 1994, p. 88).

In Bangladesh, the *dhormo* of girls is “marriage and the successful discharge of the roles of daughter-in-law, wife and mother” (Blanchet 1984, p. 119; Blanchet 1996, p. 49). This *dhormo* should not be underestimated: in the Bengali culture motherhood “is more than a role, it is a religion, the ultimate purpose of womanhood” and “a woman who is not a mother is an incomplete person, a failed woman” (Blanchet 1996, pp. 131-132). She has no status and no say in household decision-making until she becomes a mother (Mukhopadhyay and Savithri 1998, p. 28). As pointed out by White (1992, p. 98) marriage in Bangladesh is essentially contradictory: it is both a prime mean of female subordination as well as the culturally accepted basis of women’s fulfilment and advancement. Regarding motherhood, she observes a similar contradiction. Despite the highly celebrated status of motherhood, it involves according to White (1992, p. 110) also “a loss of the sense of self and one’s personal boundaries”. A case in point is that when girls marry and move to their in-laws’ home, they are just called *bou* (housewife, wife, bride or daughter-in-law), until they give birth to a child and are called mother-of-so-and-so which entails an higher status (Blanchet 1996, p. 54; Carr et al. 1997, p. 222; White 1992, pp. 110-111).

Islam (1999, p. 85) concludes that adolescent childbearing and motherhood are highly valued in Bangladeshi society since 78 per cent of the births to adolescents are *wanted*. As in India it is believed that the proven fertility of the newly-wed girl enhances her status (Barua and Kurz 2001, p. 58). The birth of a child is also believed to contribute to spousal satisfaction, with notably lower rates of divorce (Alam et al. 2000b, p. 12; White 1992; Nahar and van Ginneken 1997). Particularly the woman is socially stigmatised because of infertility (Papreen et al. 2000, p. 3). It is estimated that childlessness underlies 8 per cent of the deaths due to suicide among women of reproductive age in Matlab between 1987-1998 (Ahmed et al. 2004, p. 316). Age at first marriage is often considered equal to age at sexual initiation. In Bangladesh, effective married life begins almost immediately after the marriage ceremony or, in a few cases, within 6 months at the most (Fauveau 1994, p. 21). Despite this occasional period of post-marital habituation, the birth of the first child follows relatively soon after marriage; in Matlab for instance in the order of 1 to 2 years thereafter (Fauveau 1994, p. 110). (Adolescent) fertility is determined by various factors that are either behavioural or biological in character (Bongaarts and Potter 1983), which we briefly discuss below.

Behavioural factors affecting (adolescent) fertility

Behavioural factors that impact adolescent fertility are the frequency of intercourse, induced abortion and contraceptive behaviour. Little is known about the frequency of intercourse among adolescents (and adults) due to the private nature of the subject (see for instance the study by Ruzicka and Bhatia in 1978, cited by Becker 1993, p. 37). Induced abortion is for cultural and religious reasons illegal in Bangladesh under the Penal Code of 1860, except for those cases where the life of the woman is in absolute danger (Ross et al. 1996, p. 20). Studies on induced abortion are scarce in Matlab (Ahmed et al. 1998; Johnston 1999) and little is known about abortion among adolescents in this area. During 1976-1989, 19 per cent of the maternal mortality among 15 to 44-year-old women in Matlab was related to abortion (Fauveau 1994, p. 122).

Contraceptive behaviour among adolescents in Bangladesh is documented, although for cultural reasons, family planning services have traditionally been offered to married women of reproductive age in Bangladesh (Francisco de 1996, p. 10). Unmarried but also newly-wed adolescents often lack adequate information, skills and resources needed to prevent unwanted pregnancies and sexually transmitted diseases, for which girls are disproportionally vulnerable as compared to boys (WHO 2000, p. 1; UNFPA 2003, p. 23)[22]. Schools in Bangladesh generally lack legislative backing to undertake sex education and they often cannot obtain approval of parents. Typically, children and adolescents learn about sex through friends or similar-aged relatives as a result of which often incorrect or highly exaggerated information is passed (Verma et al. 1997, p. 483).

Islam and Mahmud (1995, p. 25) state that knowledge of contraceptives is "almost universal among both adolescents and adults in Bangladesh". However, further investigation reveals that almost all of their interviewees were *aware* of certain methods but did not know how to use them effectively. Similar findings are described by Pachauri and Santhya (2002, p. 186) with reference to adolescents in the South Asian region as a whole. In a study by Alam (2002b) among sexually active boys of 14 to 19 years, it was found that they were reluctant to use contraception claiming that sexual intercourse must take place several times before conception can occur and that it is unlikely that sexual intercourse with an adolescent girl will result in pregnancy because she is not physically mature enough. The proportion 'ever used a contraceptive method' in Bangladesh amounted to 26 per cent among married adolescent girls aged 10 to 19 years, against 48 among adults (Islam and Mahmud 1995, p. 26). Whereas contraceptive pills as well as intrauterine devices (IUDs) and injectables are popular, condoms are quite unpopular (Francisco de 1996, p. 11). They

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[22] Two-thirds of all reported STDs in Bangladesh occur among people under 25 years of age and the incidence is much higher among women aged 15 to 19 years than among men of the same age (Gubhaju 2002, p. 19). Worldwide, HIV/AIDS has become a disease of young people, with young adults aged 15 to 24 years accounting for half of the approximately 5 million new cases of HIV infection each year (UNFPA 2003, p. 23). In Bangladesh, the HIV/AIDS epidemic seems so far to develop at a slow pace and seems to be concentrated within high-risk sub-groups (FHI 2001; FHI 2003).

are more used by young men rather than by adult men (Islam and Mahmud 1995, p. 27).

Biological factors affecting (adolescent) fertility

In a normal population conception rates are about 20 to 30 per cent per cycle (Hamilton-Fairley and Taylor 2003, p. 6). The chances of conceiving in adolescence are in general lower due to a period of *postmenarcheal* sub-fertility, related to the probability of absence of menstrual periods (amenorrhea), non-ovulatory menstrual cycles (anovulation), infrequent or irregular menstrual cycles (oligomenorrhoea), infrequent or irregular ovulations (oligoovulation), and the probability of foetal loss. Particularly, in adolescence not all cycles are ovulatory and cycle length may be variable (Gray 1993, p. 221). Irregularities after menarche may last 5 years (Metcalf et al. 1983). It is estimated that 60 to 70 per cent of the cycles are ovulatory among 15 to 19-year-old girls in developed nations, but whether this finding also holds for developing countries is unclear (Becker 1993, p. 33). Malnutrition may increase the incidence of anovulatory cycles. Adolescent sub-fertility may also be due to early foetal loss (before the pregnancy is recognised). The probability of foetal loss is higher among adolescents as compared to women in their twenties (Becker 1993, p. 40). Despite the lower chance of conceiving and higher probability of early foetal loss in adolescence, Bangladesh is among the countries with the highest levels of adolescent childbearing: 117 births per 1000 girls aged 15 to 19 in 2002 (UNFPA 2003, p. 71). In Matlab, the mean ages of women at first conception were on average 18.3 years in 1977, 19.5 years in 1982 and 20.3 years in 1985 (Fauveau 1994, p. 110). It should be noted that the actual number of pregnancies, and hence the burden of fertility on adolescent girls, is higher because only live births are included in the numerator whereas spontaneous and induced abortions and stillbirths are excluded (UNFPA 2003, p. 82).

2.5.2 Adolescent childbearing, malnutrition and young gynaecological age

The background against which adolescent childbearing in Bangladesh takes place is as follows: 67 per cent of all pregnant women never made an antenatal care visit throughout their pregnancy; about 92 per cent delivers at home and 87 per cent delivers without skilled attendants (ICDDR,B 2002b, p. 29). The untrained relatives and neighbours who attend births generally lack knowledge of hygiene and safe-delivery practices (Ross 1996, p. 29). A cultural obstacle in this respect may be *purdah* which prescribes that a girl (or woman) is not allowed to be on her own in public places (Mukhopadhyay and Savithri 1998, p. 32), as a consequence of which she needs to be chaperoned by for instance her husband, male family member or mother-in-law, who also need to be convinced of the need to seek medical care. *Purdah* may form a burden to visit hospitals since the overwhelming majority of the doctors are men and it is culturally prohibited that a woman is to be seen, let alone physically examined, by any male other than her husband except under dire circumstances (Ross 1996, p. 30)[23]. Taking into account statistics on maternal

[23] In Bangladesh women's status, indicated by physical mobility and authority in household decision-making, is low although it differs according to individual, household and village characteristics (Balk 1997a; 1997b). Examples of women bearing their children in harsh conditions or alone are described by Blanchet (1984).

mortality, one has to conclude that adolescent childbearing brings along elevated (reproductive) health risks, both for the girl herself as well for her child[24]. In Matlab, the *maternal mortality rates* (MMRs) of girls aged 10 to 14 and 15 to 19 were respectively 5 and 2 times as that of women aged 20 to 24 years (WHO 1991, p. 6; Mayor 2004, p. 1152). The overall MMR in Bangladesh, between 4 to 6 deaths per 1,000 live births, is one of the highest in the world (Ross 1996, p. 28).

Causes of maternal mortality deaths are usually classified as direct, indirect and coincidental (for an overview and specification of causes we refer to WHO 1991). In Matlab, mortality from (direct) obstetric causes constituted 28 per cent of the total mortality among 15 to 24-year-old women during 1976-1989 (Fauveau 1994, p. 113). In terms of maternal mortality, adolescent girls basically face the same risks as other women of reproductive ages. That some risks are elevated for adolescent girls is not related to age per se, but rather to associated factors typical of adolescents in general (a *nulliparous* state), or that may considered to be applicable to adolescent girls in rural Bangladesh (*inadequate nutritional status* and *young gynaecological* age). Below these factors are described briefly.

Parity

In general, and in Matlab as well, primigravidae face substantially higher maternal mortality risks than women with pregnancies of higher order (WHO 1991, p. 413; Ronsmans and Campbell 1998, p. 286). As a child born to an adolescent girl is most likely to be the first child, the risks can expected to be higher for adolescents. However, in some countries the elevated risk of maternal mortality associated with a nulliparous state may surpass the effect of young age as such (WHO 1991, p. 413). In terms of causes of death, parity is particularly associated with hypertensive disorders of pregnancy which are in developing countries most often seen in very young women and those pregnant for the first time (WHO 1991, p. 8). In 1976-1985 hypertensive disorders of pregnancy constituted 20 per cent of the total maternal deaths among primigravidae (against respectively 11 and 0 per cent among women with prior parity 1-5 and 6+) in Matlab (WHO 1991, p. 412). When broken down by age, hypertensive disorders of pregnancy constituted 18 per cent of the total maternal deaths among girls aged 15 to 19 years, against 13 and 0 per cent among women aged respectively 20 to 34 and 35 to 44 years (WHO 1991, p. 412). Hypertensive disorders of pregnancy constitute the most important cause of death among nulliparous adolescent girls.

Malnutrition

A second factor that elevates the risks involved with adolescent childbearing is related to short maternal stature and lack of micronutrients. That girls (and women) of small stature are particularly susceptible to obstructed labour is related to the fact that height

[24] Worldwide the infant mortality rate (IMR, infant deaths per 1000 live births) among adolescent mothers is 1.5 times higher than it is among mothers aged 20 to 24 years (UNFPA 1997, p. 2). In 1996-1997, the IMR in Bangladesh among adolescent mothers was 106 against 79 for mothers aged 20 to 29 years (Mitra et al. 1997, p. 104). In Matlab, the IMR fell from 110 to 58 between 1966 and 2000 (ICDDR,B 2002a, p. 6), whereby for mothers born between 1976 and 1989, the IMR is constantly higher for infants born to adolescent mothers as compared to older mothers (Bairagi et al. 1999, pp. 58-59). In Matlab, the odds of dying during the late neonatal and post-neonatal period are even higher for second than for first children of adolescent mothers, possibly due to the depletion effect of repeated births with small spacing in between (Alam 2000c, pp. 229-236; WHO 1991, p. 6).

is correlated with pelvic size (WHO 1991, p. 6). Short women tend to have a small pelvis and for a height less than 145 cm and a weight lower than 45 kg there may be an obstetric risk (WHO 2003, pp. 22-23). Adolescent girls have, because of their age, not yet completed linear growth and are therefore likely to be shorter than 145 cm (and lighter than 45 kg), but their height and weight may as well be sub-normal because of malnutrition. Information on adolescent nutritional anthropometry is scarce (United Nations 2000, p. 2) particularly within the South Asian region including Bangladesh (WHO 2003, p. 6; p. 14). If the few studies reflect the national situation, adolescents in Bangladesh generally do not meet the necessary nutritional requirements. A survey by Shahabuddin et al. (2000, pp. 93-98) among unmarried adolescents aged 10 to 17 in rural Bangladesh revealed that 59 per cent of the girls (and 75 per cent of the boys) were thin (i.e. a low BMI-for-age) and 48 per cent of the girls (and boys) were stunted. In their study, the prevalence of 'thinness' declined by age whereas the prevalence of stunting increased by age. This points to an increased obstetric risk for adolescent girls. In India it was found that up to 67 per cent of the girls were classified as being at obstetric risk (by height and weight criteria) in their 15th year as compared to about 20 per cent in the 19th year (WHO 2003, p. 22).

Obstructive labour is commonly caused by cephalopelvic disproportion or CDP, a condition whereby the pelvis or bony birth canal is too narrow to permit easy and safe passage of the baby, particularly its head (WHO 1991, p. 8). Up to the middle of the twentieth century CDP was also common and remained one of the main causes of maternal deaths in Europe, where it was induced by childhood rickets (Gebbie 1982). The consequences of CDP relate foremost to complications attended by hours of agony that lead to higher health risks for the woman and her baby during childbirth. Without treatment a woman with obstructed labour will eventually die of haemorrhage, rupture of the uterus, infection or sheer exhaustion (WHO 1991, p. 8). Unhygienic practices by birth attendants heighten the risks as well.

With respect to obstructive labour in adolescent girls not only anthropometry of the girl herself is important but also that of the baby she delivers, notably the baby's head circumference. In general, anthropometry of the baby may be influenced by trimester-specific nutritional deprivation. When growth restriction in utero occurs early in pregnancy the infant exhibits *symmetrical* (or proportional) growth with length, weight, head and abdominal circumference all below the 10th percentile reference for a given gestational age (*stunting*), whereas when growth restriction in utero occurs late in pregnancy, the infant inhibits *asymmetrical* (or disproportionate) growth with a normal length and head circumference, but low weight due mainly to a lower proportion of visceral and fat tissue (*wasting*) (Podja and Kelley 2000, p. 6). Particularly for stunted adolescent mothers-to-be obstetric problems may occur in case of *asymmetrical* growth of the foetus, whereby only the baby's weight is subnormal but length and head circumference are normal.

In Bangladesh (1976-1985), the number of maternal deaths from obstructed labour amounts to 7, 5, and 8 per 1000 live births for women with prior parity 0, 1 to 5 and 6 and higher respectively (WHO 1991, p. 412). However, the observation that obstructive labour is not higher among nulliparous women (particularly adolescents) may be blurred because "information on the incidence of and mortality from obstructed labour is patchy, probably because in many countries deaths as a result of this condition are classified under the final cause of death, which may be sepsis, haemorrhage, uterine rupture or obstetric shock" (WHO 1991, p. 9). Particularly adolescent girls (and women) who are anaemic do not tolerate blood loss as well as healthy girls (and women), which places them at higher risks during pregnancy and childbirth, particularly in case of haemorrhage. Many adolescent girls in Bangladesh suffer from high rates of anaemia (Chowdhurry et al. 2000; Shahabuddin et al. 2000; Hasan and Ahmed 2002). Additionally they have a lower resistance to diseases, making them more susceptible to puerperal infection (WHO 1991, pp. 7-9). In general, in case of haemorrhage, treatment (blood transfusion) is required within a few hours[25]. Among adolescent girls in Matlab mortality from haemorrhage and sepsis constituted respectively 15 and 5 per cent of the total mortality from direct causes of maternal mortality in the period between 1976 and 1985 (WHO 1991, p. 412).

In general, in case an adolescent girl or woman does survive the delivery she may be seriously compromised by chronic reproductive morbidity among which *obstetric fistula*, an injury to her birth canal, which leaves her with chronic incontinence (leaking of urine and/or faeces) and possibly also frequent bladder infections, ulceration of the genital area and nerve damage to her legs. Fistula results from the prolonged pressure of the baby's head against the pelvis, which cuts off the blood supply to the soft tissues surrounding her bladder, rectum and vagina; the injured tissue rots away and leaves a hole or fistula (UNFPA 2003, pp. 39-40). The child often dies. Because of their physical immaturity, adolescent girls are particularly prone to fistula. It is estimated that fistula affects about 15 to 30 surviving women for every woman who dies in childbirth (UNFPA 2003, p. 39). To our knowledge, there are no data available on *obstetric fistula* in Bangladesh, let alone data broken down by age.

Young gynaecological age

The third factor that potentially influences adolescent childbearing is seldom made explicit as it crosscuts with small maternal stature and malnutrition. More than *chronological* age, physical 'readiness' for pregnancy and childbirth may be related to *gynaecological* age. Menarche takes place at the time of maximum increase in muscle mass and about one year after peak in growth velocity (Heald 1985, p. 52; Riley et al. 1993, pp. 56-57). Height and pelvic size are correlated and at the time of reaching menarche girls have approximately 4 per cent more height and 12 to 18 per cent more pelvic growth ahead of them (WHO 1991, p. 6). The average growth after menarche is reported to be 6 to 8 cm (Riley et al. 1993). As a general rule the earlier the menarche, the greater the growth thereafter (Lachance 1995, p. 7). Whereas in optimal conditions a girl's lean body mass may attain its adult level as early as at the age of 14 years (Heald 1985, p. 52), in some girls in Matlab linear growth continues past the age of 20 years (Riley 1994, p. 92). Growth of the pelvis may continue for some time after linear growth is complete (Riley 1994, p. 91).

[25] Excluding abortion-related deaths, almost 50 per cent of all maternal deaths in Matlab occur during labour or within 48 hours of delivery (Fauveau and Chakraborty 1994, p. 133). It is estimated that about 20 per cent of pregnancies in Matlab are complicated, out of which 10 to 15 per cent may ultimately require a caesarean section, and 3 per cent may require comprehensive obstetric care (Francisco de 1996, p. 8). The Bangladesh Service Provision Assessment Survey 1999-2000 revealed however that among facilities providing delivery and postpartum care, only 3 per cent has the capacity to carry out caesarean sections (Saha 2002, pp. 36-37).

These observations corroborate the notion of Silventoinen (2000, p. 23) that in modern societies growth usually comes to an end in (late) adolescence, but that in poorer environments growth may continue longer, which would suggest catch-up growth of the second type, i.e. longer growth but no increase in growth velocity (see also subsection 2.2.3). Undernourished girls with a delayed menarche grow more slowly but for a longer period (Gillespie and Flores 2000, p. 2). Accordingly, length of growth after menarche varies in studies from 1.4 to 5 years (Riley et al. 1993, pp. 56-57). The influence of postmenarcheal living conditions to bring about an effect on postmenarcheal growth seems to be limited. Socio-economic factors have for instance shown little impact on adult height when earlier height is controlled for (Riley 1994, p. 96). How early pregnancy interferes with the completion of growth in malnourished (stunted) girls is not fully understood (Riley et al. 1993, p. 56). There are indications that growth during pregnancy does occur in adolescent girls, particularly during the third trimester, which can have negative effects on the pregnancy outcome if additional dietary and weight gain allowances are not made (WHO 2003, p. 13, p. 36).

In sum, young *gynaecological* age (reproductive immaturity) may jeopardise the course and outcome of pregnancy through two mechanisms. Firstly, the relative immaturity of the young mother per se (i.e. smaller body size, lower weight, less well-developed reproductive organs) may place them and their infants at higher risks of poor birth outcomes. Secondly, the growth needs of the mother and foetus may create a competition for nutrients to fulfil maternal growth needs (linear growth, growth of uterus and pelvis) and to support pregnancy (Riley 1994, pp. 90-91). The uterus of young women may be structurally or functionally less able to carry a foetus to term as compared to older women (Riley et al. 1993, p. 54). In the words of Gebbie (1982, p. 669) “when stunted girls conceive and the next generation develops within them, the foetuses are not stunted and labour becomes a struggle between a genetically well-developed foetus and an environmentally deprived maternal pelvis”.

2.6 Conceptual model

In this section the conceptual model of this study (Figure 2.6) is introduced. This conceptual model is directly based on the earlier discussed Figure 2.3 which presented the lifecourse (‘life cycle’) model (section 2.3) and Figure 2.4 which summarised the determinants of menarche as identified in the literature review (section 2.4).

Figure 2.6: Conceptual model of adolescents' reproductive health and its determinants (based on Figures 2.3 and 2.4)

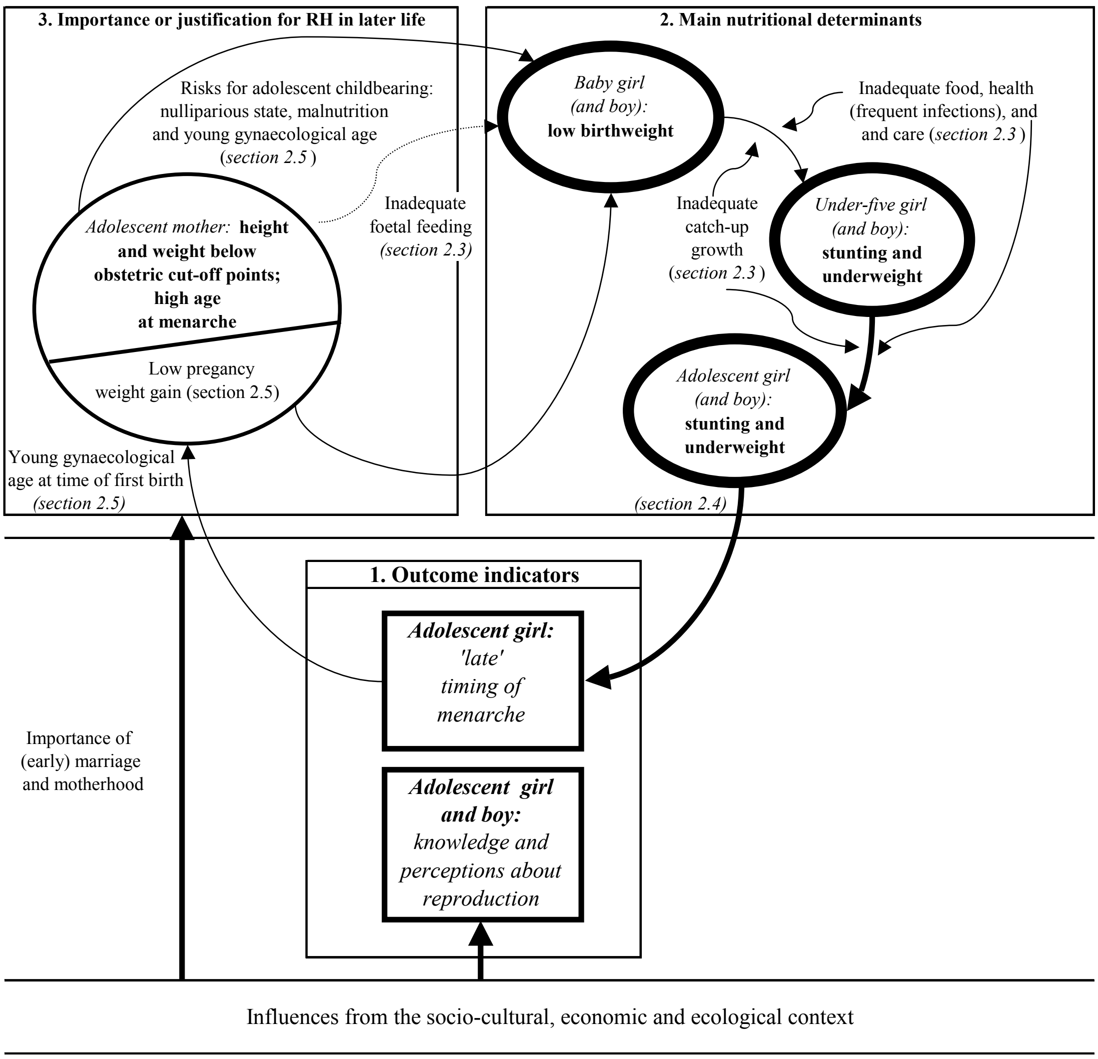


Figure 2.6 sketches over the *lifecourse* and within the *context* of (rural) Bangladesh for adolescent girls[26] the following:

1. The *outcome indicators* of adolescents' reproductive health (section 2.4), i.e.:
   - timing of menarche;
   - reproductive knowledge and perceptions.

2. The *main nutritional determinants* of timing of menarche (section 2.3), i.e.:
   - nutritional anthropometry in early life, i.e. in early childhood and at birth;
   - nutritional anthropometry in adolescence;
   - nutritional anthropometry of the adolescent's mother; and
   - (possibly) age at menarche of the adolescent's mother.

[26] For adolescent boys the pathway of physical maturation is not worked out for the period after adolescence. We do study the nutritional status career of adolescent boys empirically (Chapter 5) as well as - briefly - their timing of spermarche (Chapter 6) and their reproductive knowledge and perceptions (Chapter 7).

3. The importance or *justification* of menarche and nutritional status for future reproductive health (section 2.5), i.e.:

   - the possible consequences for adolescent childbearing due to contemporary and early life malnutrition and young gynaecological age.

Later in this book we will analyse data pertaining to part of the adolescents' lifecourse, i.e. to the period between *birth*, *early childhood* and *adolescence*. More specifically, we aim to study the *reproductive health status* of 12 to 16-year-old *adolescents*, indicated by *timing of menarche* (and *spermarche)* and *reproductive knowledge and perceptions.* We will study timing of menarche in relation to *contemporary* and *early life nutritional status*, i.e. early childhood (i.e. up to the age of five years) and birth (by means of recalled birth weight). We hereby also take into account the height of the mother and her (recalled) age at menarche.

2.7 Conclusions and discussion

This study is about adolescents' reproductive health, indicated by timing of reproductive transitions (menarche, spermarche) and reproductive knowledge and perceptions, which reflect respectively *physical* and *mental* well-being in the definition of reproductive health as formulated at the ICPD (ICPD 1994). We study adolescents' reproductive health from a *lifecourse* perspective, which is one of the angles that can be taken within the *process-context* approach. Adopting this approach to adolescents' reproductive health is rather new within the discipline of demography.

The universal character of the lifecourse refers to the occurrence of *stages*, separated by *transitions*. The combined effect of inherited traits and environmental inputs allow individuals to go through the respective stages at a different pace, and hence, timing of transitions differ. Within the lifecourse, a main developmental process is the *nutritional status career*, which is closely intertwined with the *reproductive health career*. In addition, a career of '*knowledge and perceptions*' may be distinguished.

Regarding the *nutritional career*, the statistics on LBW babies and under-five nutritional status in Bangladesh are a far from positive point of departure with regard to the nutritional and reproductive health status of children who are about to enter the stage of adolescence. Because of the rapid growth during gestation and early childhood, intrauterine conditions and nutritional status in these periods are most important for nutritional status later in life. These stages may therefore be labelled as *critical*. *Programming* - the central concept to Barker's hypothesis - describes how an early stimulus or insult operating at a critical period results in a long-term change in the structure or function of the organism. The age of two years may indicate a turning point regarding the potential to *catch up* early life growth faltering, i.e. after this age it becomes increasingly difficult to attain the adult height which would have been reached if circumstances were optimal. Catch-up growth may either take the form of an increase in growth velocity beyond normal growth for chronological age or of a growth that continues longer under a normal growth velocity regime. Whether catch-up growth takes place depends on the accumulation of risk factors during the lifecourse (*cumulative causation*). In Bangladesh, infectious diseases (diarrhoea), adverse behaviours and living conditions form the *'chain of risks'* affecting nutritional anthropometry in the negative. Girls seem to be disadvantaged in the nutritional and health domains as compared to boys.

The onset of the *reproductive career* is announced by the reaching of menarche and spermarche. Spermarche is by far less studied than menarche. Timing of menarche is in part determined by genetic reproductive endowment but is moreover influenced by contemporary and early life nutritional status, and is possibly even set in utero (*programmed*). Menarche is likely to occur 'late' if the girl has been or still is suffering from malnutrition. Despite malnutrition being highly prevalent in Bangladesh, studies on menarche in this country do not unambiguously point to a delay. However, within subgroups of girls - the severely malnourished - menarche may indeed be reached 'late'. Timing of menarche is not only an indicator of reproductive health status per se, it may also be crucial for the rest of the reproductive career and carries both physical (pertaining to the *biological clock*) and social significance (relating to the *social clock*). What is striking is the different approaches to the respective *rites of passage* passed through by adolescent boys and girls in Bangladesh. Although circumcision, which precedes spermarche, is of a different order from the reaching of menarche, a common denominator shared with menarche is that it marks the entrance into the next stage of life, including the internalisation of the corresponding modes of conducts. With circumcision, the new status of an adolescent boy is celebrated festively and made public, whereas the reaching of menarche by an adolescent girl is kept silent and generally viewed negatively because of the alleged polluting nature of menstrual blood and the new 'dangerous state' she has entered into, i.e. she sexually matured. The public acknowledgement of the transition from childhood to adulthood associated with circumcision contrasts sharply with the silence surrounding menarche.

Adolescence suggests a life in between: different from childhood but certainly not yet equal to adulthood. Such a stage, however, does not seem to correspond with the picture of the adolescent period that emerges from descriptions by Aziz and Maloney, and Blanchet. Particularly the Bangladeshi rural poor seem to consider *sabalikas* as 'little women', soon-to-be wives and mothers, whereas adolescent boys, *sabalaks,* get involved in 'on-the-job training programs' in the paddy fields and at market places, are urged to pursue economic independence. Throughout the respective sub-stages of childhood and adolescence, girls are expected to learn their gender role at an earlier age as compared to boys. In addition, the period of adolescence seems to last longer for boys as they generally marry later. Given the overall, apparently normative, emphasis put on learning and internalising adult roles, it may be argued that a distinctive period of transition between childhood and adulthood, i.e. adolescence, does not really exist in rural Bangladesh and may be no less than a theoretical construct. The onset of the period of adolescence, as well as its ending (i.e. where adulthood begins), is highly culturally determined and a function of a broad range of factors. Defining 'adolescence' in such a way that credit is given to all possible relevant factors and circumstances is hard, if not impossible, because of conflicting definitions of cut-off points. Marriage, for instance, turns a 15-year-old girl into a wife, which marks the end of her adolescent period. However, it remains to be seen whether such a (sudden) start also indicates 'adulthood' in physical terms, as her body is not yet fully grown, but is rather as equally immature as that of her unmarried peers.

How pregnancy in an adolescent girl interferes with her own growth and reproductive maturation is not exactly known. There are however indications that catch-up on early life growth faltering in adolescent girls is characterised by a growth that continues longer than usual while growth velocity does not change. This may have serious implications for adolescent girls' reproductive health because of the longer period required to achieve maturity of the reproductive organs, such as the pelvis. Consequently, these girls would typically reach physical 'readiness' for childbirth also at a later stage. The light herewith shed on timing of menarche is manifested in *gynaecological* age, the time in years since menarche. Young *gynaecological* age (immaturity of the young mother-to-be) may not only jeopardise the course and outcome of the pregnancy but is likely to increase the risk of obstructive labour as well, herewith endangering the life of the adolescent mother and that of her baby. *Gynaecological* and *biological* age (indexed by nutritional status) rather than chronological age seem most important to an adolescent girl's reproductive health status. Young *gynaecological* age is only one side of the coin: socio-cultural norms favouring early marriage and childbirth provide the counterpoint in the framework on adolescents' reproductive health.

3 Research design, data and methods

3.1 Introduction

As set out in Chapters 1 and 2, indicators of adolescents' reproductive health status that we consider are respectively the timing of reproductive *transitions* (menarche and spermarche), and reproductive *knowledge and perceptions*. We view adolescents' reproductive health status from a *lifecourse* perspective, which entails a focus on both contemporary as well as early life conditions and contextual circumstances. The underlying mechanisms determining adolescents' reproductive health status refer to *processes* or changes over time (nutritional status development, socialisation) whereby determinants are embedded within nested multi-level (micro, meso and macro) *contexts*. The overarching research question, formulated in section 1.3, reads as follows:

What is the reproductive health status of adolescent girls and boys in Matlab, Bangladesh, and to what extent is this status associated with contemporary and early childhood nutritional anthropometry?

The research set out to answer this question is guided by five research sub-questions broken down in two components that represent respectively the *physical* and *mental* well-being of adolescents' reproductive health (see section 1.3).

This chapter describes the research design, data and methods and is organised as follows. We first formulate the respective hypotheses that guide us through the subsequent analyses (section 3.2), after which we present the operationalisation of the main variables (section 3.3). Studying adolescents' reproductive health by taking a lifecourse approach requires a longitudinal design. Data collection took place in three villages belonging to the Matlab *thana*, in collaboration with ICDDR,B. We describe some of the features of this unique study site and the system of data collection by ICDDR,B (sections 3.4 and 3.5).

In order to gain insight into the two most important *age-graded* influences on adolescents' reproductive health status - physical maturation and socialisation (see subsection 2.2.2) - we set up a database containing longitudinal data collected in two surveys conducted within a 13-year interval. Our study thus entails a so-called *fixed cohort design*, meaning that "no entries in the cohort are allowed during the follow-up period" (Kleinbaum et al. 1982, p. 3). The first survey, that serves as a baseline, was conducted in 1988-1989 among under-five children (n=707) by Baqui, a paediatrician affiliated with ICDDR,B at that time. We review some of the main characteristics of this survey (section 3.6). We undertook a second, follow-up, survey in 2001 among the same individuals in their adolescence (n=569), i.e. those still alive and living in Matlab according to the latest information routinely collected in the *Health and Demographic Surveillance System* (HDSS) of ICDDR,B. In order to learn more about prevalent perceptions about reproductive health, additional information was collected among a selection of the adolescents under survey, their parents and key persons through in-depth interviews. The follow-up survey and the in-depth interviews are described extensively (section 3.7). This chapter closes with a discussion of the conclusions (section 3.8).

3.2 Hypotheses

This section introduces the hypotheses that are derived from the literature review as presented in Chapter 2. Basically, the hypotheses referring to the *physical well-being* of adolescents' reproductive health stem from the assumption that the timing of menarche is determined by contemporary as well as early childhood conditions, notably nutritional anthropometry (see subsections 2.3.1, 2.4.1 and 2.5.2). The mental well-being of adolescents' reproductive health, indexed by reproductive knowledge and perceptions, is mainly analysed in the context of socialisation in rural Bangladesh (see subsections 2.3.2 and 2.4.3). Next, following the order of the main research questions (as laid out in section 1.3), some main findings from the literature review are evaluated (what is currently known, what is not equivocal and the gaps in knowledge), followed by the formulation of the respective hypotheses.

<u>Principal research questions (menarche-related):</u>

- *Question 1*: What is the reproductive health status of adolescent girls and boys as indicated by timing of menarche and spermarche respectively?

- *Question 4*: Is timing of menarche predisposed by contemporary and early childhood nutritional anthropometry, birth weight, as well as height and age at menarche of the adolescent girl's mother?

  <u>Focus in literature review:</u>

  Subsection 2.4.2 on timing of menarche and its contemporary and early childhood nutritional determinants.

- Age at menarche of mothers and their daughters is positively correlated (Gray 1993, p. 220). However, the predictive power of age at menarche of a girl's mother is small (Graber et al. 1995).
- Nutritional status is one of the most important non-genetic determinants of menarche (Riley et al. 1993, p. 50). In the early 1970s, timing of menarche was believed to be 'triggered' by a certain critical weight (Frisch and Revelle 1969; 1971) but the evidence for this relationship was weak (Trussell 1980). In later studies, other anthropometric indices such as adolescent height, MUAC and BMI were (also) positively associated with menarche (for instance, Delgado et al. 1985; Linhares et al. 1986; Maclure et al. 1991; Koprowski et al. 1999). More recently, there is growing support for the possibility that timing of menarche may be set in utero or early in life but may be modified by changes in body size and composition in childhood (Silva et al. 2003, pp. 405-412).
- However, one should exercise caution as only a handful of reports hint at fetal determinants of age at menarche (Rich-Edwards 2002, p. 27) and some studies did not find a detectable effect of in utero famine exposure on age at menarche (see, for instance, Lumey and Stein 1997, p. 1964; Khan et al. 1995, p. 1092).
- To date, there is no agreement regarding the relevant 'critical period' for determining menarche (Rich-Edwards 2002, p. 28).
- Girls born with a low birth weight for gestational age are more likely to have experienced menarche by the age of 14 years as compared to their peers with a birth weight appropriate to gestational age (Koziel and Jankowska 2002, pp. 268-

269). The impact of a smaller size at birth may be compensated by a higher postnatal weight gain (Cheung et al. 2002, p. 335; Silva et al. 2003, pp. 405-412).

Hypothesis 1: Timing of menarche of mothers and daughters is positively, though weakly, correlated.

Hypothesis 2: Adolescent girls who were malnourished according to anthropometry as an under-five child are more likely to reach menarche 'late' as compared to their well-nourished counterparts.

Hypothesis 3: Adolescent girls who were born with a low birth weight reach menarche earlier than girls with a higher weight at birth.

<u>Principal research questions (related to nutritional status):</u>

- *Question 2*: What is the contemporary nutritional status, as indicated by anthropometry, of adolescent girls and boys, and does this differ by sex?

- *Question 3*: Is nutritional anthropometry in adolescence predisposed by nutritional anthropometry in early childhood, birth weight, and height of the adolescent's mother? And, related to this, is there any potential to catch up early childhood growth faltering in adolescence?

  <u>Focus in literature review:</u>

  Subsections 2.3.1 and 2.5.2 on adolescent nutritional anthropometry and the predisposition by nutritional anthropometry in early life.

- Information on adolescent nutritional anthropometry is scarce (United Nations 2000, p. 2), particularly within the South Asian region including Bangladesh (WHO 2003, p. 6; p. 14). Adolescents in Bangladesh generally do not meet the necessary nutritional requirements and are chronically malnourished (Shahabuddin et al. 2000, pp. 93-98).
- In Bangladesh, 50 per cent of children are born with a low birth weight (LBW, i.e. below 2500 grams) (WHO 2003, p. 8) and almost 60 per cent of the under-fives suffer from malnutrition (ICDDR,B 2002b, p. 36).
- In the three villages that constitute our study area, in 1988-1989, 73 to 78 per cent of under-five children were underweight (<-2 SD) (depending on the three-month period considered during these two years), whereas the corresponding data for childhood stunting (<-2 SD) ranged from 68 to 76 per cent, respectively (Baqui 1990).
- Apart from the period of gestation, growth velocity never becomes higher than in infancy. Consequently, growth faltering in infancy is most detrimental, in the sense that "stunting at this phase is more difficult to recover in the future than a delay during a later age" (Silventoinen 2000, p. 23). The potential for catch up faltering growth (stunting) in childhood is believed to be limited after the age of two years, particularly when such children remain in poor environments (Gillespie and Flores 2000, p. 2).
- The potential for significant catch-up in adolescence is small and may be limited to the brief period of pre-pubertal growth spurt, some 18-24 months immediately preceding menarche (WHO 2003, p. 22).

Hypothesis 4: Nutritional status of adolescents as indicated by anthropometry is poor.

Hypothesis 5: Malnutrition, as indicated by the level of stunting, is more prevalent among adolescents who were stunted in early childhood as compared to adolescents who were not stunted as an under-five.

Hypothesis 6: Adolescents who were already stunted at the age of two years are more likely to be stunted as compared to their not stunted same-aged counterparts in early childhood.

Focus in literature review:

Subsection 2.3.1 on the intergenerational cycle of growth failure: adolescent nutritional anthropometry is in part predisposed by maternal nutritional status.

- An impaired nutritional status may be passed on from mother to child: birth weight of children and that of their mothers is associated (van der Veen 2001, pp. 53-58); mother's stature is a predictor of a child's height (Silventoinen 2000, p. 16); and mothers' BMI is strongly positively related to height and BMI of her sons at ages between 7 and 15 years (Eriksson et al. 1999, pp. 427-431).
- Rural Bangladeshi women are considered to be chronically malnourished (Fauveau 1994, p. 111; Ross et al. 1996, p. 10; WHO 2003, p. 8).

Hypothesis 7: The likelihood of being stunted in adolescence is greater for adolescents whose mothers are stunted than for adolescents whose mothers are not stunted.

Focus in literature review:

Subsections 2.2.3, 2.3.1 and 2.3.2 on the differences between girls and boys in terms of nutritional anthropometry and potential to catch up early childhood growth faltering.

- Within the context of fetal programming boys are in general more sensitive to nutritional deprivation than girls (Barker 1998).
- However, during infancy and childhood the opposite - girls being more vulnerable than boys - may be true with regard to intra-household distribution of food and care within Bangladeshi society: by the time she reaches puberty a Bangladeshi woman has already experienced a lifetime of discrimination compared to males (Ross 1996, p. 5), including the nutritional and health domain (D'Souza and Chen 1980; Chen et al. 1981; Bhuiya et al. 1988; Razzaque 1989; Bairagi and Chowdhury 1994; WHO 2003, p. 15).
- Discrimination of girls is negligible in small families but much higher in families with more than two girls (Ross 1996, p. 5).
- Boys and girls have different rates of growth during adolescence (Bianculli 1985, pp. 49-53) and the spurt occurs two years later in boys than in girls, but is greater and lasts longer in boys (Lachance 1995, p. 7; WHO 2003, p. 10).

On the basis of the literature, different - even opposite - hypotheses could be formulated, whereby the focus could either be on the difference in growth spurt (which may result in girls seemingly having a greater catch-up potential than boys), or differences in feeding patterns and care-giving behaviour of parents towards sons and daughters, causing the intergenerational cycle of growth failure to be gender-specific, affecting girls in particular, and possibly counterbalancing girls' catch-up potential.

> Hypothesis 8: Both in early childhood and adolescence, girls are more likely to be malnourished as compared to their male counterparts.
>
> Hypothesis 9: Girls are more likely to catch up early childhood growth faltering in adolescence than boys.

Principal research question (related to mental aspects of reproductive health status):

- *Question 5*: Are adolescent girls and boys informed about and prepared for menarche and spermarche respectively, and reproductive development in general?

    Focus in literature review:

    Subsection 2.4.3 about the way adolescent girls and boys in Matlab, Bangladesh, are socialised and the socio-cultural connotations attached to reproductive transitions in adolescence, notably menarche and spermarche.

- For Bangladeshi girls, menarche is both an important event in their lives as well as a very private matter, generally looked upon negatively: menstruation in general is considered shameful (Begum 2000) as the blood is regarded as the greatest of all pollutions (Blanchet 1984, p. 33).
- In Bangladesh, adolescent boys do not have much knowledge about spermarche (Khan et al. 2003, p. 18) and they link masturbation to harmful 'impairments' such as gonorrhoea, impotency, early ejaculation, infertility or deformed children later in life, or to a general loss of health, charm and happiness (Aziz and Maloney 1985; Khan et al. 2003, p. 15).
- Mothers seldom talk to their daughters about menstruation (Blanchet 1984, pp. 38-39; Ross et al. 1996, p. 32; Akther et al. 1999, p. 5).
- Regarding sexuality, 'innocence' is expected from adolescent girls and guilt and punishment are consequences for not observing the role that is in accordance with the expected state of 'understanding', i.e. what it is they are expected to know as morally good and to practise it according to their life's path and dhormo in life (Blanchet 1996, pp. 47-48).
- Particularly in late childhood and adolescence the worlds of boys and girls in Bangladesh become increasingly segregated. Girls contribute to child care, food preparation and other household tasks, and sons work for wages from a young age (Mukhopadhyay and Savithri 1998, p. 26). Being responsible for their family's contact with the larger community, the focus or 'world' of boys becomes larger. When girls grow up, their lives are increasingly confined to the home yard of their family (and later family-in-law).

> Hypothesis 10: Adolescent girls and boys are not or insufficiently informed or prepared for menarche and spermarche respectively, and reproductive development in general, and girls are less informed than boys.

3.3 Operationalisation of main variables

We consider adolescents' reproductive health status to consist of a *physical* and *mental* component, whereby the outcome indicators are timing of menarche and spermarche on the one hand and reproductive knowledge and perceptions on the other (section 1.1). Timing of menarche is in part determined by genetic reproductive endowment but is moreover influenced by contemporary and early childhood nutritional status, and is possibly even set in utero (see subsection 2.4.2 and the conceptual model as presented in section 2.6).

In this subsection, operational definitions of the *main* variables included in the analyses are presented (Figure 3.1). Some of the variables pertain to the period of *adolescence*, for which data were collected in the follow-up survey in 2001 (primary data); some of the variables pertain to information about the *childhood* of the study population, for which data were collected in the baseline survey in 1988-1989 (to us, secondary data); and some variables pertain to the period of *birth* of the study population, for which data were collected *retrospectively* in the follow-up survey in 2001 (primary data). The methods of *secondary* and *primary* data collection are described in sections 3.6 and 3.7 respectively. This section is organised as follows. First the operationalisation of 'timing of menarche and spermarche' (physical component of adolescents' reproductive health) is discussed (subsection 3.3.1), followed by the operationalisation of 'nutritional status' (subsection 3.3.2). After that, the topics selected to study adolescents' reproductive knowledge and perceptions (mental component of adolescents' reproductive health) are operationalised (subsection 3.3.3).

It should be noted that contextual variables (for instance those pertaining to the household in which the child or adolescent is growing up) as well as variables reflecting general demographic and socio-economic characteristics of the study population will be discussed and operationalised in Chapter 4.

Figure 3.1: Operationalisation of main variables

Birth (1983-1984) Collected retrospectively in 2001	**Childhood (1988-1989) Baseline survey**	**Adolescence (2001) Follow-up survey**
Constitution - Sex - Recalled birth weight - Recalled size at birth - Recalled timing of birth	**Nutritional status** - Weight, weight-for-age *(underweight)* - Height, height-for-age *(stunting)* - Mid-Upper Arm Circumference *(MUAC)*	**Nutritional status** - Weight, weight-for-age *(underweight)* - Height, height-for-age *(stunting)* - Body Mass Index *(BMI)*
Anthropometric and reproductive endowment - Height of mother - BMI of mother - (Recalled) age at menarche of mother		**Timing of reproductive transitions** - (Recalled) age at menarche (girls) - (Recalled) age at spermarche (boys)
		Knowledge and/ or perceptions of: - Menarche (girls), spermarche (boys) - Menstruation (girls) - Other indicators of development - Human procreation - Future marriage and childbearing - Contraceptives - HIV/AIDS

3.3.1 Physical reproductive health status in adolescence

In this study physical reproductive health status is indicated by timing of menarche and spermarche. Data on menarche and spermarche were collected by retrospective recall among the adolescent respondents (see also section 3.7). The recall method of reporting age at menarche may not be optimal, but is usually the only source of available information (Graham et al. 1999, p. 259). Accuracy of short-term recall among adolescent girls was relatively high in a study of Koo and Rohan (1997, pp. 61-64), where 66 per cent was able to recall the age at menarche correctly. In addition, we asked every adolescent girl's mother in retrospect to recall her age when she menstruated for the first time. An event such as the first menstruation is usually not easily forgotten, but having to recall an event over a long time is far from easy, although some - relatively old - studies of Damon et al. (1969) and Livson and McNeill (1962), referred to by Becker (1993, p. 23), point out that recall errors are fairly random, i.e. show "no systematic bias in retrospective reports". Nevertheless, extra caution while analysing these data is needed.

We consider timing of menarche to be:
Early, if reached at an age equal or younger than 11 years;
On time, if reached at an age between 12 and 13 years; or
Late, if reached at an age of 14 years or older.

We accommodated our data on menarche, which are recorded in full years[27], to the cut-off points as fixed in a study of Ge et al. (1996) on psychological distress as a potential consequence of early physical maturity. In their study, the age boundaries for 'on time' and 'late' physical maturity are respectively between 12.5 to 13.5 years and older than 13.5 years. In our analyses, we also compared a girl's age at menarche with the age at menarche of her mother. We accounted for *censored* cases, i.e. girls who were still premenarcheal at the moment of interview.

3.3.2 Nutritional status by anthropometry

Basic anthropometric measurements

Nutritional status can be measured in many ways, but in our study it is confined to anthropometry. Next, we devote a few words on the measurement of anthropometry in general, after which we describe which nutritional indicators have been generated for the study population in adolescence and in early life, and which nutritional indicators we applied to describe maternal nutritional status. Finally, we elaborate upon the choice of reference populations used.

- Weight:

  In the follow-up survey, weight of the adolescent respondents and their parents was measured on digital weighing scales that were accurate to the nearest 0.1 kg (following WHO guidelines), and which we borrowed from UNICEF. The scales were calibrated in the field against known weights (of 1, 2, 3 or 5 kg

[27] Given that studies on spermarche are scarce (subsection 2.4.2), timing of spermarche is also operationalised by age (in years).

stones). The respondent was asked to stand on the scale without wearing shoes or jewellery (except for small items such as a nosering or earring) and to stand still for at least five seconds. Weight was measured twice, the second time with the scale placed on a different spot. Later a mean was calculated on the basis of the two measurements.

In Baqui's survey (our baseline), under-five children were weighed without their clothes or with light clothes using a calibrated Salter-type spring scale to the nearest 0.1 kg following WHO guidelines (Jelliffe 1966). Their scales were standardised frequently against known weights (Zaman et al. 1996, p. 310).

- Height:

In the follow-up survey, adolescent and parental height was measured by means of a wooden height-meter. One height-meter was available at the Matlab Field Research Station (see also section 3.5). For this study we had nine such meters made by a local carpenter. The respondent was asked to step on to the wooden platform of the meter, to stand up straight, with his or her heels together and touching the wooden stick, with bare feet, and looking at the horizon. The height-meter was accurate to the nearest millimeter. As a height-meter is not subject to 'mechanical-errors' and as height was usually read off from the stick by more people than the interviewer only (the porter, bystanders), the risk of errors was considered nil. For the sake of convenience height was therefore measured only once.

In the baseline study, recumbent length of all children younger than 36 months was measured by using a locally constructed length board, whereas standing height of children aged 36 months or older was measured to within 0.1 cm with a height stick. In order to reduce observation errors, the under-fives' anthropometric measurements were read by two observers independently, and the mean of the two measurements was recorded (Zaman et al. 1996, p. 310).

- MUAC (mid-upper arm circumference):

In the follow-up survey, MUAC was taken for all respondents by means of the tape, which we borrowed from the Matlab Cholera Hospital. The tapes were accurate to the nearest millimeter. First, if necessary, the respondent was asked to raise his or her sleeve of the right arm. Then the interviewer put the tape on the bare upper arm, in linear direction, starting on the bulge (bone) of the shoulder up to the hinge joint on the outside of the elbow (the elbow was bent in the direction of the respondent's abdomen). The part of the tape indicating the length between shoulder and elbow was folded equally into two. By halving the distance between the shoulder and tip of the elbow the mid-point of the left upper arm was found and marked with a red pencil. The actual measurement could be taken by wrapping the tape around the upper arm, while making sure that the small pencil-mark came into view in the window of the tape. After the tape was pulled tightly (but not too tight) around the upper arm, its circumference could be read off. Taking this measurement is a precise task and requirLes Meilleurs Disc1es, apart from experience, a lot of patience from both the respondent and the interviewer. We considered the risk of reading off the circumference wrongly, after being so precise with taking the measurement and in the presence of others (the porter, bystanders), to be small. Taking this measurement also demands a lot of co-operation from the respondent. We therefore measured the mid-upper arm circumference only once.

In the baseline survey, MUAC of the under-five children was also assessed, using a TALC tape, with measurements to the nearest two millimeter (Baqui 1990, p. 77).

Generating indicators of nutritional status for adolescents

Anthropometric assessment is more complex in adolescence than in childhood because of changes in body composition and the variable timing of the growth spurt (WHO 2003, p. 29). Adolescent growth is usually monitored by using the following anthropometric indices or combinations of measurements (WHO 2003, pp. 10-12):

- Underweight or low weight-for-age. A low weight-for-age may be difficult to interpret because it may be due to either acute or chronic undernutrition (FAO and WHO 1992, p. 11).

- Stunting or low height-for-age. A low height-for-age reflects chronic malnutrition or long-term nutritional deprivation (FAO and WHO 1992, p. 11). Stunting is also referred to as 'shortness' (CDC 2000, p. 85). Stunting is influenced by malnutrition over generations (Leemhuis-de Regt 1998, p. 111).

- Thinness or low BMI-for-age. Body Mass Index (BMI) indicates weight relative to height and is calculated by weight in kg divided by height^2 in metres (FAO and WHO 1992, p. 11). BMI ranges from underweight or thin to overweight or obese, where increased mortality rates are found in both underweight and overweight subjects (FAO and WHO 1992, p. 11). BMI is the same as the Quetelet Index and indicates CED or Chronic Energy Deficiency.

Generating nutritional indicators for under-five children

The growth of under-five children is usually also monitored by the indicators 'underweight' and 'stunting'.[28] However, research conducted in Matlab has led to the recommendation to use MUAC as a predictor for the risk of dying from malnutrition rather than weight-for-age (underweight) (Fauveau 1994, p. 444). We used underweight, stunting (see above) and MUAC to describe nutritional status in early childhood. Weight-for-age and height-for-age can be calculated for individuals up to 18 years of age (CDC 1999, p. 6).

[28] The nutritional indicator 'wasting' or low weight-for-height ('thinness'; CDC 2000) is not used in this study. Wasting reflects acute shortage of food and is a sensitive indicator, used for instance in emergency situations and in the event of a famine (Leemhuis-de Regt 1998, p. 111). Weight-for-height is only calculated for male children up to 138 months of age or 11.5 years and less than 145 cm tall, and for female children up to 120 months or 10.0 years of age and less than 137 cm tall (CDC 1999, p. 6). Given that this indicator cannot be applied to adolescents, and given our need to make nutritional comparisons over time and hence maintain consistency of indicators, we did not use this indicator to describe the nutritional status of the study population in childhood.

- A low MUAC is an indicator of acute malnutrition or level of wasting. MUAC measures the amount of muscle, fat and bone in the arm. In 1 to 5-year-old children the average normal MUAC hovers around about 16 cm (Cameron and Hofvander 1983, p. 16). A MUAC of less than 12.5 cm shows severe malnutrition in children, a MUAC below 11 cm is very serious ('emergency cut-off point'), and a MUAC below 22.5 cm indicates severe malnutrition in adults (Leemhuis-de Regt 1998, pp. 111-112).

Generating nutritional indicators for the adolescents' mothers

In this study the nutritional status of the biological[29] mothers of the adolescents is reflected by their weight, height and BMI[30].

Generating nutritional indicators reflecting conditions at birth

We take into account birth weight, size at birth and timing of birth for gestational age, all as perceived by the adolescents' mothers by recall in the follow-up survey in 2001. Birth weight was measured in grams (as a continuous variable), and size and relative timing were measured on an ordinal scale.

Conditions at birth, indicated by:
Recalled birth weight: normal (>2000 grams) or light (≤2000 grams);
Recalled relative size at birth (perceived as small, normal or tall); and
Recalled relative timing of birth (perceived as early, on time or late).

Reference populations

The assessment of anthropometric measurements involves a comparison with a reference population (of same sex and age) that is known to be adequately nourished. We analysed nutritional status, as represented by weight-for-age and height-for-age, by using the nutritional anthropometry program 'NutStat' of EPI info 2000, version 1.1.2 (CDC 2000). The respective nutritional indices are expressed in Z-scores, also referred to as Standard Deviation (SD) units (CDC 1999, p. 5). The Z-score in the reference population has a normal distribution with a mean of zero and a Standard Deviation of 1 (CDC 2000).

[29] We cannot guarantee that we measured anthropometry of the 'genuine biological' mothers (and fathers), since we relied on reports of the mothers (and fathers) themselves (confirmed by the HDSS household cards, which are discussed in section 3.5). Biological connections were not confirmed by, for instance, blood or DNA tests.

[30] Though transmission to the child from the paternal side seems far less influential (Silventoinen 2001, p. 16; van der Veen 2001, pp. 53-58) - see also subsection 2.3.1 - we also attempted to collect anthropometric data of the adolescents' fathers. However, anthropometry was assessed for only 18 per cent of them (corresponding to 124 fathers). Among the non-responses, 86 per cent of the fathers was absent because of work and 9 per cent of the fathers was no longer living. Absence because of work is related to the fact that within a Bangladeshi setting most men work and most women stay at home, whereas the follow-up survey was conducted during the day. Given that a) we do not know anything about anthropometry of the majority of fathers, and b) the related selection effects (fathers who did stay at home may have done so because of reasons such as nutritional-status-related sickness or handicap, and fathers who passed away may have died because of a cause directly or indirectly related to malnutrition), we decided not to consider paternal anthropometric data in our analyses.

The Z-score is calculated as follows (WHO 1995):

$$\frac{\text{(observed value) - (median reference value)}}{\text{(standard deviation of reference population)}}$$

We have purposely chosen to use Z-scores as they are most used worldwide (except for the United States where percentiles are generally used as cut-off points) and are favoured by the WHO (CDC 2000). NutStat allows for calculating Z-scores on the basis of two different reference populations of the United States Centre for Health Statistics (US NCHS): the CDC/WHO reference population of 1978 and the CDC reference population of 2000. We applied the reference population of 1978 to the nutritional analyses of the under-fives in 1988-1989 and the reference population of 2000 to the nutritional analyses of the same population in adolescence in 2001. The rationale for this selection was that these two reference populations are as close as possible in time to the year of measurement of anthropometry of the study population in childhood and adolescence respectively. Cut-off levels for grades of malnutrition are given in Figure 3.2.

Figure 3.2: Grades of nutritional status according to SD and BMI classification

Children and adolescents			Mothers	
SD classification[a]	Weight-for-age	Height-for-age	Nutritional grade	BMI[b]
Above -2 S.D. from the median	Normal	Normal	2nd Degree overweight (obestity) 1st degree overweight (obesity) Normal	> 30.0 25.0-30.0 20.0-25.0
Between -3 S.D. and -2 S.D. from the median	Moderate underweight	Moderate stunting	Low normal 1st degree underweight	18.5-20.0 17.0-18.5
Below -3 S.D. from the median	Severe underweight	Severe stunting	2nd degree underweight 3rd degree underweight	16.0-17.0 < 16.0

[a] *United States Centre for Health Statistics (US NCHS) (FAO and WHO 1992; CDC 2000; NNMB 2002)*
[b] *Based on the 'James classification' (Jelliffe 1966)*

In general, a level of minus 2 SD (or <3rd percentile) is taken as the cut-off point or threshold, below which the status is considered unsatisfactory, that is, undernutrition exists (FAO and WHO 1992, p. 11; WHO 1995, p. 271).

Four additional methodological notes should be made. First of all, it is necessary to consider *what* indicator should be used to assess an association between a given status in adolescence (for instance, menarche status or stunting or height-for-age status) and early life factors that have been operating during an - assumed - ‘critical’ period. Stunting, for instance, is known to have its origins earlier in life. The critical period for growth faltering in length is between 6 and 18 months (Liu et al. 1998, pp. 247-260). The early life origins may, however, extend back to “malnutrition over generations” (Leemhuis-de Regt 1998, p. 111). Similarly, height is largely determined by leg length, and leg length is in turn “a marker of early growth of the long bones at specific hormonally controlled phases of development” (Langenberg and Marmot 2003, pp. 614-616). Underweight (weight-for-age) may also be due to either acute or chronic malnutrition (Leemhuis-de Regt 1998, p. 111).

The second note pertains to the use of BMI. This indicator is more appropriately used to reflect *adult* underweight or overweight. BMI is not considered a suitable measurement for adolescents because of the rapid growth spurts typical of this stage in life. Within these growth spurts, increases in weight and height do not necessarily proceed in a balanced way. As a consequence, there are currently no accepted BMI reference curves available for children or adolescents (CDC 1999, p. 30). Scores for adolescent BMI would fall below the scales generally used (see Figure 3.2). Although BMI may not be an appropriate indicator for adolescent nutritional status as such, it is plausible to assume that *across* adolescent populations worldwide developments in weight and height develop in a comparable manner. We therefore expressed BMI scores of the adolescent boys and girls from Matlab in terms of Z-scores, with the reference population comprising a similar-aged and well-nourished population of the same sex (the CDC 2000 reference population of US NCHS). With this analysis, we aim to contribute to the exploration of appropriate reference curves for adolescents, with special reference to those from Matlab, Bangladesh.

Third, we should mention that in this study menarche and nutritional status (indexed by anthropometry) are conceptualised as lying on a causal pathway, where nutritional status determines timing of menarche. The data on menarche status of the adolescent girls were, however, collected on the same day as the anthropometric measurements. This brings us to the concept of 'reversed causation'. Given that among *postmenarcheal* girls, the anthropometric data were collected *after* menarche took place, the pathway could equally be the other way around: timing of menarche (which we consider the dependent variable) may influence nutritional weight and height (which we consider the independent variables). It is relevant to note in this respect that 31 per cent of the postmenarcheal girls in our sample reached menarche within the preceding 12 months, whereas the other postmenarcheal girls reached menarche on average 2.6 years earlier.

Fourth, it should be noted that in Baqui's survey (our baseline) anthropometry of the under-five children was assessed a variable number of times, with a maximum of 14, within approximately two years time. We first determined the weight-for-age and height-for-age values (expressed in Z-scores) for each measurement that was available by comparing it to the body measurements of well-fed and healthy persons of the same sex and age (using the CDC/WHO 1978 reference population of US NCHS), where age was expressed in months. Given our main research goal to study the association between nutritional status in childhood and adolescence, we needed to construct a kind of 'summary' reflecting the under-five child's weight-for-age and height-for-age profiles. We constructed this 'summary profile' by calculating a mean based on the maximum number of weight-for-age and height-for-age values available for each child.

3.3.3 Mental reproductive health status in adolescence

Apart from the *physical* component, we also distinguish a *mental* component of adolescents' reproductive health status, in which the outcome indicators reflect the adolescents' reproductive knowledge and perceptions, including emotions (section 1.1). More specifically, based on studies reviewed in particular in section 2.4.2, the following topics were selected for analysis: adolescents' knowledge and perceptions about reaching menarche and spermarche; postmenarcheal girls' perceptions about menstruation in general; perceptions about other indicators of adolescence apart from menarche and spermarche; adolescents' knowledge of human procreation; adolescents' knowledge and perceptions about future marriage and the risks associated with early childbearing; adolescents' knowledge of contraceptives, and finally their knowledge and perceptions about HIV/AIDS. Some of these topics pertain directly to the period of adolescence (for instance, perceptions about reaching menarche), whereas others specifically refer to future reproductive health events for which adolescents need to be prepared. The focus on future reproductive health involves, for instance, taking marriage and childbirth into consideration, but also the maintenance of reproductive and sexual health status by knowing how to protect oneself against HIV/AIDS.

Perceptions of menarche and spermarche, indicated by:
the first reaction on reaching menarche and spermarche respectively.
Preparedness for the reaching of menarche and spermarche, indicated by:
awareness of menarche and spermarche before its onset; and
perceived possibilities to discuss these events with others afterwards.

Social significance of menarche and spermarche, indicated by:
changes due to reaching menarche and spermarche.
Perceptions of menstruation in general, indicated by:
regularity of menstrual cycle;
reports of pain or complaints ascribed to the menstrual cycle; and
perceived excessive bleeding.

Perceptions and knowledge about (self-reported) indicators of adolescent development other than menarche and spermarche, indicated by:
self-reported indicators of development; and
sources of information about development in adolescence.

Knowledge about human procreation, indicated by:
the ability of adolescents to explain about becoming a parent; and
the ability to estimate at what time of the month conception is most likely[31].

Knowledge and perceptions of future marriage and childbearing, indicated by:
perceived 'best' age for marriage and childbirth; and
knowledge about problems associated with early (adolescent) childbearing.

Knowledge about contraception, indicated by:
awareness of contraception;
the ability to explain methods of contraception;
knowledge about where to obtain contraceptive methods; and
the ability to estimate prices of contraceptive methods.

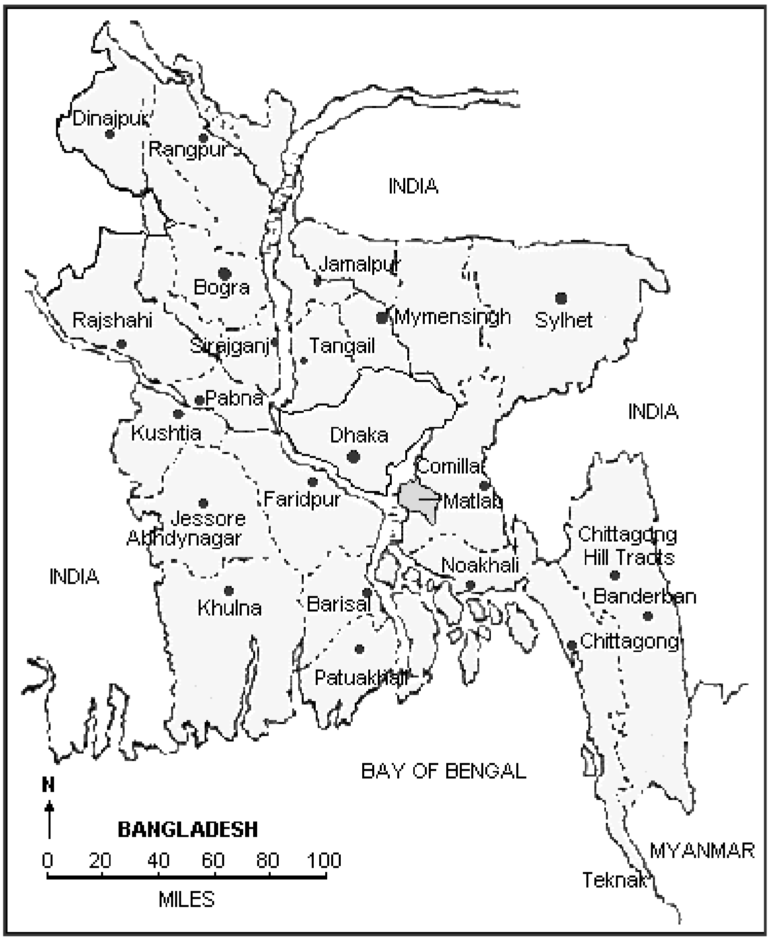
Knowledge and perceptions about HIV/AIDS, indicated by:
awareness of sexually transmitted diseases (STDs) and HIV/AIDS;
perceived likelihood of being infected in the absence of physical signs[32]*; and*
perceived modes of transmission of the HIV virus.

[31] Also tested among men in India: 21 per cent of them knew at what time of the month conception is most likely, i.e. about 2 weeks after menstruation (Bloom et al 2000, p. 244).

3.4 Study site: Matlab

The fieldwork was situated in three villages: *Charmasua*, *Saidkharkandi* and *Baluchar*, all administrated by the Farazikandi Union. These villages are all located in the larger Matlab *thana*, or '*upazila'*, a subdivision of Chandpur District (former Comilla District). The central town of the *thana*, Matlab, is situated about 50 km southeast of Dhaka, the national capital (see Figure 3.3).

Figure 3.3: Map showing the location of Matlab in Bangladesh



Over 88 per cent of the population in Bangladesh is Muslim; in 1988 Islam was declared the state religion (Amin et al. 1997, pp. 270-271). The population density in Bangladesh was about 755 per km^2, and hence the highest in the world (Islam and Mahmud 1995, p. 22). It increased to about 982 per km^2 in 1994 (CIA The World Factbook 2004). Population density becomes higher during the monsoon season when water levels may rise up to four metres as compared to the dry winter period, and most of the villages and hamlets become crowded clusters of islands[33] (Fauveau 1994,

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[32] Also tested among men in India: 29 per cent of them believed that asymptomatic STD is possible (Singh et al. 1998, p. 392).

[33] A dramatic example of a monsoon flood is the one that occurred in July 2004, one of the worst floods in years, and it made approximately 20 million people in Bangladesh homeless (Moszynski 2004, p. 247).

p. 14). It is estimated that no less than 70 per cent of the country's surface is covered by water. The whole Matlab *thana* is located in a delta, which is intersected by numerous canals and the tributaries of two major rivers, the *Padma* (or *Ganges*/*Gumti*) and the *Meghna*, respectively. The population of *Matlab* numbered just over 218,000 in 2000 (ICDDR,B 2002a, p. 21). Given the climatological characteristics, from a logistical point of view the fieldwork was scheduled during the most favourable seasons: in late winter, spring and early summer, long before the monsoons and accompanying floods begin, so that it was still possible to reach the study villages within a reasonable time.

In the Matlab *thana* a so-called *Treatment* area is distinguished from a *Comparison* area (see also section 3.5). Our three study villages are located in the *Comparison* area. A year before the baseline study, in 1987, the three study villages were different in size: *Baluchar* was the smallest with 1453 inhabitants; *Charmasua* had a total population of 1900 and *Saidkharkandi* had 3416 inhabitants (Baqui 1990, pp. 54-55). Just before the follow-up survey, in 2000, the population had increased to 2039 in *Baluchar*, 2119 in *Charmasua* and decreased to 1417 in *Saidkharkandi* (ICDDR,B 2002a, pp. 95-97). As the three villages are very near each other, the geographical and environmental conditions of these villages can generally be considered the same. One difference, however, is that *Baluchar* and *Charmasua* are located near the river *Dhonogoda*. Both villages are intersected by the river embankment. *Saidkharkandi* is located away from the river (Baqui 1990, pp. 54-55).

The main occupations in Matlab are to be found in the agricultural domain, and, not surprisingly in such a water-rich area, many people earn their living from fishing. The methods of both agriculture and fishing are traditional, characterised by techniques that have been in use for centuries. The common crops that are cultivated are rice, millet, jute, pulses, oil seeds, potatoes, wheat, onions, chillies, turmeric and others, with the cultivation of rice occupying most of the arable land. Jute, as a cash crop, is grown only in small quantities by a few well-to-do agriculturists (Fauveau 1994, p. 14). The number of people earning a living by means of traditional occupations is declining, while more and more have occupations in business and services (Razzaque et al. 1998, p. 1). In 1996, about 12 per cent of the household heads in the *Comparison* area derived their main income from a (small) business. As in most rural areas in Bangladesh, women generally do not have an occupation but stay in the *bari*[34], where they do the housework and look after the children. In the study villages overall socio-economic status is low, although it is somewhat higher in *Baluchar* and *Charmasua* compared to *Saidkharkandi*.

3.5 Data collection by ICDDR,B

In the absence of a national vital registration system, *demographic information* on the population of Bangladesh has historically come from two primary sources, i.e. surveys and sample vital registration surveillance systems (Ross et al. 1996, p. 9). Health and Demographic Surveillance Systems hardly exist on their own but are always related to (public) health or epidemiological studies (for instance medical

[34] (Kin-related) 'homestead' organised around a common courtyard (see Appendix A).

trials), for which it is also necessary to collect vital statistics that mainly serve as denominators.
For nearly four decades (since 1966), ICDDR,B has collected data in Matlab. The Matlab Field Research Station has done successful research in the field of large-scale trials of the efficacy of population-based health interventions, including several cholera vaccine trials, population-based epidemiological studies on diarrhoea, and behavioural and demographic studies. Each individual living in the Matlab area has a permanent registration number, i.e. the Registration IDentification (RID) number. The RID number enables researchers to link information about a large population over time. This makes the Matlab data unique: the complete demographic life history of every individual born in the research area has been recorded. Although data have been collected for almost four decades, longitudinal data sets have been analysed to a limited extent only.

At present, a population of approximately 210,000 is under observation in 142 villages[35] in Matlab, Bangladesh. In this Health and Demographic Surveillance System (HDSS), Community Health Workers (CHWs) collect data on all vital events (birth, death, marriage and migration) as well as on the occupations and education of all individuals. CHWs visit each household once a month (formerly fortnightly). The head of the household identifies those he (a female head of the household is rare) considers to be a member of the household. The CHW registers every demographic event concerning the household and reports these once a month to one of the Health Assistants (HA) at the Matlab Field Research Station. The data are entered in Matlab and subsequently transferred to the HDSS-department of ICDDR,B in Dhaka (Ross 1996, p. 22).

In 1977, the Matlab area was divided into two parts: one *Comparison* area and one *Treatment* area. In both areas health services of the government are available but in the *Treatment* area special and extra services for Maternal and Child Health and Family Planning (MCH-FP) are provided by ICDDR,B. In this *MCH-FP* area, a programme was initiated which provides health services to *married* women (14-49 years) and under-five children (Ross 1996, p. 11). Additionally in 70 villages situated in the *Treatment* area, information on reproductive events and status (lactating, menstruating, pregnant), maternal morbidity and under-five morbidity are collected in Record Keeping Systems (RKS). The RKS covers approximately 16,000 women (RKS-M, operative since 1978) and 18,000 under-five children (RKS-C operative since 1986). Malnourished children in the RKS-C can be hospitalised in the nutritional rehabilitation centre of the Matlab hospital (Fauveau 1994, p. 53). RKS data are updated every month by CHWs and the procedures on data processing are similar to that of the HDSS (Ross 1996, p. 23).

Representativiness of data collected in Matlab

Data collected in Matlab may suffer from selectivity: the intensive MCH-FP projects mean that inhabitants of Matlab have relatively more access to health care and are more exposed to Western cultures (through researchers), compared to inhabitants of other rural parts of Bangladesh. Accordingly Ross (1996, p. 13) notes that "the number of interventions within the study population has led to a widespread perception that the population is no longer representative of rural Bangladesh, let

[35] Due to river erosion the number of villages decreased by seven in 1987 (ICDDR,B 2002a, p. 3).

alone rural areas of developing countries as a whole". Our study was conducted in the *Comparison* area, in which far fewer studies are being conducted and which is not exposed to services provided by ICDDR,B within the framework of the MHC-FP programme. The birth and death rates in 2000 in the three main study villages were respectively 27.8 and 8.5 (*Charmasua*), 27.5 and 7.8 (*Baluchar*) and 26.8 and 5.6 (*Saidkharkandi*) per 1,000 of population and hence do not differ much from the overall figures for the *Comparison* area (respectively 27.7 and 7.2), but are slightly higher[36] than those for the MCP-FP area (respectively 24.9 and 6.8) (ICDDR,B 2002a, pp. 95-97). In terms of number of persons enrolled, our sample is relatively small: 707 under-five children were enrolled at baseline in 1988-1989, 569 of them were followed up in 2001 and we subsequently succeeded in interviewing 482 adolescents. Our sample is thus not representative for Matlab, let alone Bangladesh.

3.6 Under-five children: baseline (secondary) survey

Neither HDSS nor RKS contains detailed information on anthropometry. However, data of this kind are occasionally collected in so-called *Special Studies*, which are studies carried out for specific purposes. In order to obtain information about the nutritional status of adolescents during their childhood, several databases for *Special Studies* were explored during a feasibility study conducted from March to June 1997 at ICDDR,B in Dhaka and Matlab (Bosch and Hutter 1998).

Given that our research focuses on the early life determinants of adolescents' reproductive health, we selected a study entitled *"Epidemiology of persistent diarrhoea in Bangladeshi children*" to act as a baseline. This study was conducted by Baqui, a paediatrician affiliated to ICDDR,B, among under-fives in three villages (*Charmasua*, *Saidkharkandi* and *Baluchar*) located in the Matlab *thana* in the period January 1988 to December 1989. More specifically, we selected his study because of the following two criteria:

- as the study was conducted in 1988-1989 (all children were born after 1 April 1984; Baqui 1990, p. 56), the subjects would be aged 12 to 16 years in 2001; and
- the information collected provided enough possibilities to assess the nutritional status of children.

The prospective study by Baqui aimed to describe and quantify the problem of persistent diarrhoea in under-five children in rural Bangladesh and to identify some of its most important risk factors. Results have been published in several leading journals (Baqui 1990; Baqui et al. 1992; 1993a; 1993b; Zaman et al. 1996; 1997). The three villages in which Baqui carried out his study "were chosen and no scientific sampling techniques were applied" (Baqui 1990, pp. 53-54). The main criterion for selection was that the villages were believed to be representative of the Matlab *Comparison* area (Baqui 1990, p. 54). Other criteria were that the villages were located at least five km away from the Matlab hospital and that "the population was reasonably cooperative" (Ibid. 1990, p. 54). Before commencing the survey, consent for the study was obtained from the formal and informal community leaders, whereas during the survey signed consent was obtained from the parents (Baqui 1990, p. 57).

[36] Except for the death rate in Saidkharkandi, which is slightly lower when compared to the figure for the MCP-FP area.

Initially 707 children were enrolled (387 boys and 320 girls) in Baqui's study, between 0 and 59 months old. Of these, 696 children were followed up prospectively from May 1988 to April 1989 (Zaman et al. 1996, p. 310; Zaman et al. 1997, p. 923). At the beginning of the study 575 children were recruited, whereas 121 newborns were added during the survey. A total of 512 children were followed up for the full year. The remainder of the children were not followed up for the full year due to prolonged absence, migration and refusals (Zaman 1996 et al., p. 310). Three children died (Zaman et al. 1997, p. 923). The children who dropped out of the study did not differ from the others in their nutritional status (Zaman et al. 1997, p. 923). The under-five mortality rate in the *Comparison* area decreased between 1988 and 2000 from approximately 150 to 80 per 1000 live births (ICDDR,B 2002a, p. 13). The same period was characterised by out-migration. Net migration rates in 1988 and 2000 were approximately -17 and -16 per 1000 population for men and -12 and -9 per 1000 population for women (Ibid. 2002a, p. 16). Given these statistics on mortality and migration we had to account for loss of follow-up in 2001.

In Matlab, deaths and causes of death have been registered over a period of almost 40 years. Consequently, children who died before reaching the stage of adolescence can be traced by their RID number. By cross-checking various HDSS data sets of ICDDR,B, we were able to select only those households for interviewing where we knew in advance that the adolescent-respondent had not passed away or migrated since early childhood. Analysis of mortality by cause of death and migration of the individuals who were lost for follow-up is presented in Chapter 4.

3.7 Adolescents: follow-up (primary) survey

In this section, we briefly highlight some features directly related to the fieldwork carried out between November 2000 and May 2001.

3.7.1 ICDDR,B's review boards

In accordance with the research protocols of ICDDR,B the fieldwork could only start after the study and the proposed method of data collection had been approved by ICDDR,B's Research Review Committee (RRC) and Ethical Review Committee (ERC). Defences before the RRC and ERC took place in November 2000. While during the defence before the RRC the social and scientific relevance and the design of the study were emphasised, the ERC members were mainly concerned about the type of questions, the phrasing of the questions and the rights of the study population. In particular the consent form (prepared according to ICDDR,B standards; Appendix B), along with the procedures for obtaining consent (both in English and Bangla), and the Questionnaire (Appendix C) were thoroughly reviewed by the ERC.

Both for the survey and the in-depth interviews consent was required from the individuals involved. For adults we assumed that they were capable of providing informed consent, unless there was evidence to the contrary. For children and adolescents, however, the issue was not capacity but autonomy. Acquiring parental consent before starting the interview was especially important because confidential information was collected. It should be noted in this respect that reproductive health research, especially among (unmarried) adolescents, is relatively new in Bangladesh and therefore followed critically. After having made some minor adjustments to our proposed plan, both the RRC and ERC committee gave approval for the study.

3.7.2 Project staff

Knowing the travel time to and from the study villages and assuming that it would also take some time to trace a particular adolescent, we expected that only two interviews could be conducted per interviewer per day. With a six-day working week, this meant that in order to follow up 569 adolescents (see subsection 3.7.7), eight to nine interviewers would have to be hired for three months. Given the sex distribution of the study population (387 boys versus 320 girls, see section 3.6) the aim was to recruit five male and four female interviewers. Considering the Bangladeshi cultural context, adolescent girls can only be interviewed by female interviewers and adolescent boys by male interviewers. The advertisement that was posted on the notice board of the Matlab Field Research Station listed the following requirements (according to what we thought would be most important) for the post of junior interviewer. He or she would have to:

- be a resident of the Matlab ICDDR,B project area[37] (the candidates were asked to be stationed in Matlab);
- be aged between 20 and 40 years on 31 January 2001;
- have at least two years of practical experience in a similar job;
- have passed the Secondary School Certificate (SSC) examination; and
- be capable of reading and writing basic English.

During this week a research assistant was also hired in Matlab and she came to work for the study as a Field Research Officer (FRO). As the PI (Principal Investigator, author of the current thesis) lacked sufficient knowledge of Bangla - the national language of Bangladesh - or the dialect of Bengali spoken in Matlab, the FRO also functioned as an intermediary between her and the Bangladeshi staff. During the course of the fieldwork, the FRO proved to be an invaluable source of information about the Bangladeshi way of life in the area of study.

As in the research history of Matlab most of the projects are focused on maternal and child health, there is in general a greater need for female than male interviewers. While reviewing the letters of application we saw that there was a higher number of female applicants. The quality of the letters of women and the relevance of their working experiences reflected their suitability as compared to their male counterparts who were relatively more educated.

The shortlisted candidates were invited for a written test to ascertain their understanding of the English language and to test their comprehension of the subject of research, namely adolescents' reproductive health, followed by an interview. At the interviews, emphasis was placed on the applicant's communicational skills, personality ('open-minded' with respect to the discussion of reproductive health and related issues) and enthusiasm expressed for the study's objectives. It became clear that despite the applicants' relatively high educational levels, their ability to speak and

[37] This requirement complied with the outcome of negotiations between ICDDR,B and the local council who were concerned with opportunities for the employment of inhabitants of Matlab.

understand English was minimal. Finally, four male and four female applicants were invited to join the 'Adolescents' reproductive health' (ARH) team. During the course of the survey an additional female interviewer was hired while one of the male interviewers, who did not fulfil his duties adequately, was dismissed. All interviewers ranged in age between 26 and 37 years. Three men and two women had passed the pre-Masters examination (comparable to a Bachelors degree) that follows the Higher Secondary Certificate (HSC) examination. All other interviewers recruited had passed the HSC examination.

Three of the interviewers, two men and one woman, were not married. Of boys or young unmarried men it is accepted that they talk about 'things' they are not expected to have experienced, given their marital status. For the female interviewer, on the other hand, the marital status is very important, as only married women or women who have been married are usually considered to be no longer 'ignorant' with respect to reproductive health matters. Initially there was therefore some hesitation to hire the unmarried female interviewer. This female candidate was, however, accepted because she declared that her marital status had never been a problem in previous research on contraceptive use. Her experience was that many respondents simply assumed that she was married *because* she was talking about contraception. To the few who did question her marital status, she tended to reply that she might not have any practical experience since she was unmarried, but that she did have sufficient theoretical knowledge, '*just like a doctor who studies things from the books'*. This was generally accepted. Still, in order to avoid questions about her marital status this female interviewer often wore a *sari*, the 'dress' that is generally worn by married women only, while conducting the interviews. A *shelwar kamiz*, the 'dress' worn by teenage girls and unmarried women, is however also worn by married women more and more for convenience's sake, so even wearing this outfit did not directly raise questions while she was carrying out her job.

In addition, nine male porters, or logistical assistants who accompanied the interviewers in the field, were recruited. The porters were selected mainly on the basis of their domicile: seven of the eight porters were living in one of the three study villages. Apart from saving costs of transportation, this selection was made in view of the idea that these men would know the study area and its inhabitants best and would therefore most likely be able to help with tracing the adolescents. The tasks of the porters were threefold. Firstly, they helped to trace the adolescents and prevented the interviewer from getting lost in the paddy fields. Secondly, they carried heavy materials such as the height-meter and the weighing scale. And thirdly, they accompanied the interviewer for safety reasons. In particular, for female interviewers it was necessary to be accompanied by a man.

During the course of the survey the porters were given an additional role: that of 'caller to order' within a *bari* while the interview was being conducted. It was very important that the adolescent respondent be interviewed in a private setting, either outside or inside the house. Often, however, curious neighbours and relatives of the adolescent tried to listen in and interfere with the interview. The porters kept these people at a distance from the interview and 'entertained' (read: distracted) them with gossip and small talk. Also, in the case of a refusal, which fortunately did not happen too often, a porter - being a fellow villager - occasionally went to the sceptical household in the evening hours to explain over a cup of tea once again the purpose of the study and to remove possible misunderstandings. Often in this way he succeeded in setting up a date for the interview after all.

The one porter who lived in Matlab travelled with the team to the villages every day and brought with him all eight (borrowed) weighing scales that were housed at the Matlab Field Station. For the sake of convenience, the big wooden height-meters were stored in the houses of two families who lived in *baris* that were closest to the riverside in *Charmasua* and *Baluchar*, where they were picked up every morning by the interviewers and their porters. During the fieldwork several occasional staff members were recruited, mainly from Matlab. They either worked on a daily basis or were hired to complete a certain job, for instance entering data obtained from the survey.

3.7.3 Fieldwork logistics

The three study villages were relatively near the Matlab Field Research Station, at a distance of about ten kilometres (as the crow flies), but because they were located across rivers the total travel time to reach them was about 30 minutes. Depending on the weather and political situation, the team made use of various means of transportation (by foot, *rickshaw*, car or speedboat), thus crossing various rivers and paddy fields.

A note should be made about *hartals*, or national strikes, as there were so many - more than 20 days during the entire period of fieldwork - and they therefore impacted on the progress of the work. Most *hartals* were declared by the opposition (political) party in order to press the governing party to call for national elections. Sometimes relatively small groups of Muslim fundamentalists also called for *hartals*. On *hartal* days it is generally believed to be too dangerous to travel, including travelling over water, as this is interpreted as a public rejection of the strike. In a rural area like Matlab, the population is in general more relaxed and most work continues on *hartal* days. Despite this, ICDDR,B's policy on *hartals* days is to be on the safe side by explicitly disallowing any use of their motorised transportation, except for ambulances. Because of this, on these days the team of interviewers hired a local '*tempo-boat*' for as long as the *hartal* lasted or they travelled by *rickshaw*. The only drawback was that in this way the travel time to the respective *baris* was doubled.

3.7.4 Questionnaire

The English questionnaire was translated into Bangla and is accompanied by a corresponding instruction manual (Bosch 2001). The questionnaire is module-structured and consists of thirteen modules, indicated by a letter (not in alphabetical order). The modules that generated the data on which this dissertation is based are included in Appendix C. On the cover page, the administrative and logistical information pertaining to the adolescent and the interview were noted. Name, address and date of birth were checked by means of the Family Visiting Card (FVC) to make sure that the adolescent in question was indisputably the adolescent selected. When the interview was finished, the interviewer filled in an evaluation form.

The interview began with interviewing the adolescent's mother (Module I). Information about the conditions of the birth of the adolescent were collected from the mother by retrospective recall. The mother was also asked about her age at menarche. In cases when the biological mother could not be interviewed, an attempt was made to interview another close relative or neighbour, provided that this proxy could give the information at first hand (for instance if the proxy was present at the birth of the adolescent).

Thereafter the adolescent respondent was interviewed. Central to Module A is the general profile of the adolescent. Module B followed with questions about his or her living conditions. Module D dealt with the whole process of the marriage match, from the first proposal onwards, to the ultimate decisions taken with regard to the price of the dowry (if a dowry was exchanged). This module, as well as the next one (Module E) about contraception, was considered potentially sensitive. Extra tact and understanding were asked of the interviewers when they interviewed the adolescent about these topics. It should be noted that if an adolescent girl was married, a special version of Module D was used that was tailored to her particular status. The succeeding Module F on ambitions and expectations was initially believed to be less stressful, apart from the questions about the adolescent's childbearing preferences. Core information about reproductive health and development was collected in Module K and in Module X which involved taking anthropometric measurements: height, weight[38], and mid-upper arm circumference (MUAC). Given the topic, Module K was made sex-specific (adolescent boys and girls were asked different questions).

3.7.5 Training and pilot survey

Training

The interviewers were trained for one week in order to make sure that they had mastered the most elementary techniques of interviewing and learned about the background, aim and design of the study on the basis of the (anonymous) results of the written test. The manager of the Matlab Field Research Station was also invited; he elaborated on the working rules and ethics of ICDDR,B. A small tour around the Matlab Field Research Station was made, not only to show where specific divisions of the ICDDR,B hospital were located, but also to introduce the ARH team to the other ICDDR,B staff members.

To facilitate locating the respondents, a brief training session was conducted to familiarise the interviewers with the HDSS of ICDDR,B. Emphasis was placed on the role of the RID and the CID number. Apart from these numbers the HDSS computer printouts also provided us with the names and sex of the adolescents and their date of birth. However, all this information was not enough for locating a particular person. We also needed to have the corresponding name of the *bari*, the name of the neighbouring *bari* (as not every *bari* is known to everyone, the more names of *baris* the better) and the names of the adolescent's father and mother. The latter information was all to be found in the HDSS books that are stored in the HDSS room of the Matlab Field Station.

On the basis of copies of recently completed HDSS forms the interviewers were asked to look up specific information (the current address of person X with CID number Y)

[38] Pregnant women were excluded from the analyses of nutritional status.

in the HDSS room. Even for the experienced interviewers, who worked with the HDSS forms before, this turned out to be a useful exercise. Furthermore, several aspects of the interview and interview techniques were discussed, in particular with reference to the introduction and the end of the interview, the consent form and ethical aspects of interviewing. It was stressed that the consent form needed to be read aloud to the respondent, his or her mother (if present) or one of the guardians. Only when the potential participant indicated that he or she fully understood the explanations about the study and his or her rights as a participant, would he or she be asked to sign or thumbprint the consent form. In the consent form it was also emphasised that all information obtained would be handled with care and regarded as strictly confidential.

Most of the training week was devoted to a discussion of the questionnaire and practise with taking anthropometric measurements. In many aspects it was important to discuss the questionnaire thoroughly with the team. Firstly, obviously the interviewers needed to have a good understanding of the questionnaire. They needed to know exactly what the aim of a particular question was, how the question should be asked, and when to exercise extra tact in the case of sensitive questions, for instance. Secondly, the discussion was a valuable check on the quality of the translation. It became apparent that there is some difference between 'Dhaka-Bangla' and 'Matlab-Bangla', as spoken by the inhabitants of Matlab. The proposed questions and answer categories were sometimes formulated too academically, with the result that they would not be understandable to the people in the villages, or would have inadvertently resulted in a social distance between the interviewer and the respondent. Many suggestions for simplification and justification of the questionnaire were brought up by the interviewers and the FRO, who were - as noted earlier - all residents of Matlab. In addition, the knowledge and experiences of the interviewers and the FRO were utilised to adjust or update questions and the answer-categories, and to shorten the questionnaire as a whole. Other staff members of the Matlab Field Research Station were also consulted on this point.

Pilot survey

A pilot survey was carried out among 24 adolescents and their mothers in order to pre-test the quality of the questionnaire in the field. The pilot survey was conducted in *Dighaldi*, a village relatively far from the Matlab Field Research Station, in the *MCH-FP* area. The rationale for selecting this village, instead of one of the adjacent villages, was that the latter villages are selected for the purposes of pilot surveys far too often. Pre-tests need to be conducted on people very much like those sampled. Having never or seldom been interviewed before, we expected that adolescents from *Dighaldi* would be comparable to the adolescents in our study villages in the *Comparison* area. In terms of educational level and socio-economic status, the inhabitants of *Dighaldi* were believed to be comparable to those of the study population; the 2000 birth and death rates in *Dighaldi* (23.0 and 6.4 respectively; ICDDR,B 2002a, p. 93) were, however, lower compared to those in the three study villages (see section 3.4).

On the basis of the valuable comments made by the interviewers, insights gained during the training and the pilot survey, a new English questionnaire was prepared, and this was considerably shorter (the respective modules lasted 20 minutes at the most). Before the follow-up survey began, a group of senior researchers from ICDDR,B, chaired by the manager of the Matlab Field Research Station, took another critical look at the questionnaire. The aim was to formulate all questions and pre-coded answers in such a way that they would relate to the 'world' of adolescents in rural Matlab. After that, the questionnaire was *back-translated* from Bangla into English by the FRO to the PI. This enabled the PI to ensure that questions and answer categories had been correctly and appropriately translated into Bangla.

3.7.6 Reflections on the survey

Start of the interview

During the pilot survey and the actual survey, it became evident that illiterate women sometimes refused to sign or thumb print the consent form because they associated this with landowners who had in the past tricked people out of their lands. Many husbands, who were in most cases absent, had impressed upon their wives not to sign any document without their permission. We therefore added the following instruction: If a woman (mother of adolescent) agreed to participate in the research but refused to sign or thumb print the consent form, the porter was asked to sign on her behalf. This signature that was placed in front of two witnesses was regarded as approval of participation. In this way, the woman's fear of signing or thumb printing any document was circumvented, and we did have in black and white a signature of approval, witnessed by at least two people.

In the introduction, the interviewers referred to ICDDR,B (they could also be recognised by their bags that carried the ICDDR,B logo), which is a well-known institute in this area. In order to ensure that the adolescent who had to be interviewed was indeed a member of the household as indicated on the basis of the HDSS information, the RID and CID numbers on the so-called Family Visiting Cards (FVC) were checked (the adolescent's name was also checked, but names appeared to be less useful as many adolescents have a nickname). These FVCs are updated once a month by ICDDR,B's Community Health Workers, and can therefore be considered accurate. Occasionally inconsistencies were found between the RID/CID and the extra HDSS information collected from the HDSS record books and the information at the FVCs. In these cases extra checks were made and the findings were discussed with the HDSS researchers at the Matlab Field Station, so that the information in either the HDSS record books or at the FVC could be adjusted.

When it was certain on the basis of the FVCs that the adolescent in front of the interviewer really was the individual concerned, the aims of the study and the purpose of the questionnaire could be explained. Here a reference was made to the study conducted by Baqui. Although the adolescent respondent did not remember having been enrolled in this study (they were too young at that time to remember), their mothers often did. Saying that we wanted to see how their son or daughter was doing, both physically and socially, after so many years made it easier to explain the rationale for the follow-up survey. Our request to sign the consent form was hardly ever turned down.

Specific instructions were given if it happened that the adolescent was found not to be at home, had moved, or died, or was too busy to be interviewed. It is worth noting that the chance of the interviewer knocking on the door of a house in which an adolescent had recently died was minimal, because of pre-checking the HDSS database. If interviewers came across a severely malnourished or ill respondent, they were instructed to inform the PI and FRO as soon as possible, after which, depending on the severity of the illness, it was decided what kind of medical help was required. Interviewers were also instructed to make a note about married adolescents, as these respondents would get a different questionnaire that was tailored to their specific status.

The duration of the interview was about 1-1.5 hours. This excluded the time needed for the introduction and explanation of the consent form. Finding a place where the adolescent could be interviewed alone also took some time. Private interviewing was, however, considered extremely important (in order to avoid 'shyness' or 'socially acceptable or expected' answers as much as possible).

Attitudes of respondents towards the interview

Most of the adolescents interviewed and their parents or guardians were more than co-operative. Adolescents often felt proud that an interviewer came especially for him or her alone and not for his or her mother or baby brother or sister, as is often the case in Matlab where most of the research involves mother and child health. Adolescents hardly ever objected to participating (see also subsection 3.7.7). However, many adolescents were shy and needed some encouragement (from their mother or from the interviewer). Within the Bangladeshi cultural setting shyness is regarded as a highly desirable trait for girls, related to modesty and obsequiousness (see, for instance, the description of *purdah* and the 'female role' in subsection 2.4.3). We also anticipated - given their age and the nature of the study - that many modules would generate extra shyness among the adolescents (such as the modules pertaining to the matchmaking and dowry[39], friendship[40], contraception, reproductive health and development). The interviewers exercised extra tact and understanding when these modules came up for discussion. As could be expected, during the course of the interview some adolescents lost concentration, despite the efforts of the interviewers (by telling jokes for instance) to keep them focused.

Some topics appeared to be sensitive because they raised painful memories. Some respondents brought up experiences such as the loss of family members, accidents, (attempts at) physical or sexual abuse and incest. This never resulted in the complete breaking off of the interview, although some questions that became inappropriate were skipped during the interview. It should be noted that in contrast to Baqui, who gave the mothers of the under-five children a towel and soap in the baseline survey, no benefits in terms of presents or money were given to the respondents in the follow-

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39 Negotiations about the matchmaking and dowry are private. A rejection by either party is after all not something anyone wants to make public. Often even the adolescent girl herself does not know about the negotiations until the process has reached a final stage. There is a great difference in the timing of telling the adolescent: boys are often informed about their upcoming marriage earlier than girls. Many people denounce the (widespread though illegal) system of dowry but in practice it continues.

40 The importance of reputation is related to marriage and dowry. Avoiding ever becoming the subject of malicious gossip is one of the most important lessons Bangladeshi adolescents grow up with. Friendship between adolescent boys and girls hardly exists or is not made public. In rural Bangladesh such friendships carry a connotation with sex and are therefore considered inappropriate.

up survey. Instead the goodwill and good name of ICDDR,B, the hospital where many peoples' lives have been saved from cholera, were emphasised.

Making the anthropometric measurements generally went well. Female interviewers interviewed the adolescent girls and their parents (mother and father) and, similarly, male interviewers interviewed the adolescent boys and their parents (thus also the mother and father). A few mothers of adolescents (n=7) refused (or the husband refused for her) to have their MUAC taken by a male interviewer because he would need to touch her upper arm. It was anticipated that this might happen but - for logistical reasons - it would have been too difficult (and expensive) to arrange for only female interviewers to make this measurement.

External interferences

In the course of the survey adolescents started talking to each other about the interview - being interviewed is of course an interesting event that needs to be shared with peers (some of whom were also selected for an interview). This probably influenced the responses of these selected peers. The quality of their answers, in terms of knowledge, for instance, might be higher. As also parents, brothers and sisters, and in particular neighbours kept their ears open, at the end of the survey period the interviewers were increasingly confronted with 'negative' reactions. On a few occasions, parents (or an elder brother who had been interviewed by another fellow interviewer the day before) refused to have their daughter (sister) exposed to '*shameful'* questions. It is illustrative in this respect that the father of a premenarcheal girl considered his daughter to be 'too ignorant' to be interviewed about contraception:

> Father: *My daughter is so young, she cannot discuss confidential subjects. Ask me the questions, then I will reply*.

Related to this, another question that now and then was perceived as '*shameful'* was the one on preferred number of children. Such a question was believed to trigger bad thoughts in the presumably innocent minds of adolescent boys and girls. In *Saidkharkandi* the team received relatively more of these negative reactions than in *Charmasua* and *Baluchar*. One interviewer was threatened with a knife in this village.

Privacy

In order to reduce the 'stress level' as much a possible and to establish a good rapport with the respondents, the interviewers were asked to conduct the interviews as if they were informal discourses rather than interviews. The interviewers in general sat close to the adolescent respondents and made them feel at ease with small talk, making jokes, giving compliments and so on before the interview started. Sitting near each other implied that both could keep their voice down, which benefited the private nature of the interview. On some occasions, however, it appeared to be difficult to maintain the private setting as relatives, friends or neighbours kept on trying to sneak into the room where the interview was taking place. Mothers sometimes also kept their children around them while they were being interviewed. As described before, the porters also had a major task here as they 'stood guard' and 'entertained' the curious people outside. Once in a while, however, people did manage to sneak into the room and if the interviewers could not deal with this immediately they often moved quickly through the questionnaire to the least sensitive modules. When they were alone again, the interview continued where it had stopped. In this way, embarrassing situations for both the interviewer and the respondent were averted.

Alternative times and places, and proxies

The interviewers were instructed to make appointments with respondents, if possible, when they crossed the respective *baris*. In this way the respondents were already prepared for the interview. Sometimes the porter was sent out half way through the first interview of the day to arrange a meeting for the second interview with a respondent in an adjacent *bari*. Although various national holidays took place in the first half of the year, coinciding with the fieldwork, these hardly impacted on the fieldwork. On some national holidays, and Fridays as well, the work even continued on a voluntary basis. On these days in particular there was a better chance of finding the adolescents at home (many adolescents who were for instance working in Dhaka also returned to their villages during the holiday for *Eid-ul Azha* on 7 and 8 March 2001).

Many of the adolescents went to school from about nine to three o'clock. No consideration was given to interviewing adolescents in the schoolyards, as a) this would have interfered with their classes too much; b) their parents or guardians would not be around to give permission for interviewing their son or daughter; and c) peers would probably have interfered too much as well. Even if peers had stayed in the classroom, the presence of friends and schoolmates in the neighbourhood may have influenced the adolescent's responses. In general, interviewers had to make many repeat visits before he or she succeeded in interviewing the selected adolescent. Not to our surprise, adolescent girls were more often found at home as they tend to be engaged in household activities, whereas adolescent boys are generally roaming around the area.

For practical reasons only in rare cases were interviews conducted in the early mornings, and then only by the male interviewers. As all but one of the female interviewers were married and had to take care of children, they were, as most Bangladeshi women, very busy in the early mornings with household tasks before leaving for work. Conducting interviews in the evening would not have been safe for the female interviewers, but it was not possible any way as the weighing scales worked on solar cells and the sun set between five and six o'clock in the evening. If the interviewer came across a mentally handicapped (or deaf) adolescent it was decided to assess his or her anthropometry only (provided that the parents or guardians approved) and instead to ask the mother (or guardian) a selected number of questions. Considering the limitations of most of these adolescents, consent was only asked of their mother or father. If a handicapped adolescent clearly showed signs of objecting, this was of course accepted.

Married adolescents

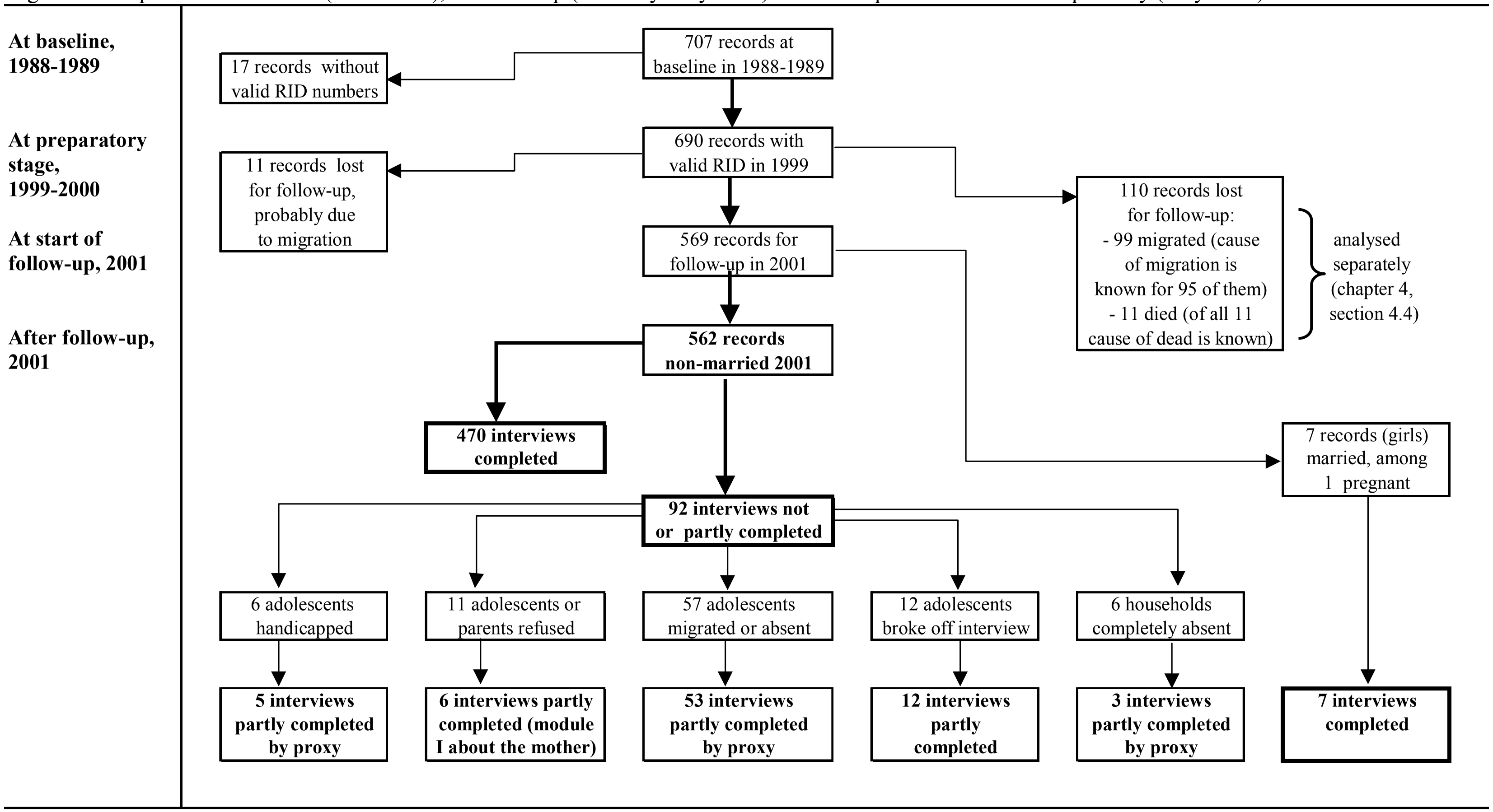
When the survey started, it was known from HDSS files that three adolescent girls were married (and none of the adolescent boys). During the course of the survey, four other adolescent girls turned out to be married as well. Given the overall statistics on adolescent marriages in Bangladesh (see section 1.1 and subsection 2.5.1) the number of married adolescents found among our study population may be considered low (though the adolescents enrolled in our study are still aged 12 to 16 years). During the follow-up survey, it was evident that adolescent marriages were indeed being planned but details about this are rarely shared with the adolescents until the negotiations have reached a final stage. Consequently, only 15 (currently unmarried) adolescents (11 girls and 4 boys) already knew the person whom they are going to marry (half of them were going to marry a family member, mainly a cousin). In retrospect we have to conclude that in order to get a better insight into the stage which the matchmaking process was in, we should have interviewed the parents or male family members instead of the adolescent. However, it is questionable whether this would have yielded relevant information, given that matchmaking is highly sensitive - being related to the reputation of the adolescent and moreover to that of the entire family - and because of the controversial character of dowry in this.

All seven married adolescents were interviewed by the same (married) female interviewer. For these married adolescent girls, the module on the matchmaking and dowry was tailored to their particular status. One married adolescent girl appeared to be pregnant. The records of the married girls were left out of the qualitative analyses. As outlined in Chapter 2 (subsection 2.3.2), post-marital residence is largely patri-local in Bangladesh. Demographic and socio-economic characteristics of the households in which these married adolescent girls live thus reflect the status of their family-in-laws and cannot be linked to conditions in their childhood. In-depth reports on some of the married girls are presented in Chapter 6.

3.7.7 Response and quality of the data

In November 2000, at the time of the RRC and ERC defences, the latest HDSS information available was the data of 1999. Of the records pertaining to the 707 under-fives who were enrolled at baseline, 690 records could be linked via the RID number to the HDSS database of 1999. Of 17 records the RID numbers were non-existent. Of the 690 individuals of whom we did have a record from 1999, a total of 110 (63 boys and 47 girls) were no longer living in the Matlab area (99 because of migration out of the HDSS area, 11 due to death). On the threshold of the follow-up survey, in January 2001, the update of the 2000 HDSS database had been completed. It became evident that of the 580 adolescents another 11 adolescents had (probably) migrated out of the HDSS area in the meantime (information on causes was not yet available). Consequently, our study population comprised 569 adolescents for follow-up, 307 boys and 262 girls. The number of 569 corresponds with 81 per cent of the original study population. The response of the 569 adolescents who were followed up in 2001 is shown in Figure 3.4.

Figure 3.4: Population at baseline (1988-1989), at follow-up (February-May 2001) and the response to the follow-up survey (May 2001)

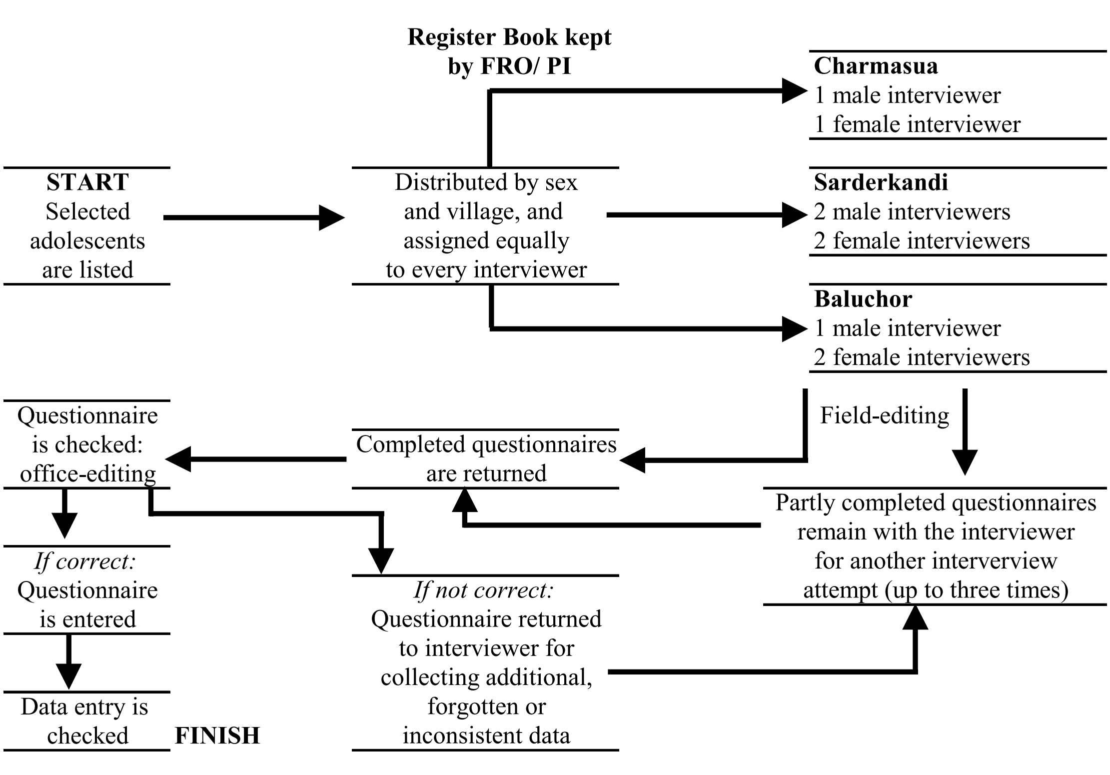


A total of 470 interviews were completed by the adolescents, which equals 84 per cent of the 562 non-married adolescent population selected for follow-up. The distribution is as follows: 85 per cent in *Charmasua*, 81 per cent in *Saidkharkandi* and 92 per cent in *Baluchar*. Despite the fact that we had made use of relatively recent HDSS information, 57 adolescents still could not be interviewed as they were temporarily or permanently absent. The capital city appeared to be the most important trigger for migration, both for boys and for girls (80 per cent of this group left for Dhaka). Boys leave for Dhaka for study or work. More and more girls from rural areas work in the garment sector in Dhaka. Only 12 questionnaires were not completed, whereas 11 adolescents, their guardians or another member of the household (grandmother or elder brother) refused to give consent for the interview. Another 6 adolescents could not be interviewed due to a mental handicap. In the majority of the cases where an adolescent was handicapped or absent, the mother, father or other relative (elder sister, aunt, live-in grandmother or aunt) was interviewed by proxy to collect (part of) the information.

Quality of the data

Every completed questionnaire was field-edited and office-edited (by the FRO and the PI) before data were entered by a data-entry typist of ICDDR,B and the PI. Data entry was done in a program developed in Blaise III (Statistics Netherlands 2000), which included several checks (internal consistency, range checks). Instead of double entering the PI checked the entry of all survey data manually. Figure 3.5 illustrates the procedure for processing the questionnaires.

Figure 3.5: Flow diagram illustrating how questionnaires are processed in the follow-up survey



In order to be able to review the quality of the data-collection process, and hence to have an impression of the reliability of the data, 10 per cent of the adolescents were re-interviewed[41] (including assessment of anthropometry) at a later stage, ranging from a few days to a few weeks later. Although it was acknowledged that some answers are likely to be different a second time - because the adolescent has grown or the situation has changed - basically the answers to both interviewers should be the same. There were no differences of importance between the results generated by the first interview and those generated by the check interview. In addition, both the PI and the FRO accompanied the interviewers regularly - every other day - in the field so that they gained a good understanding of how they worked and could check whether the interviews were being conducted correctly and anthropometric measurements were being made correctly.

The team and also the PI herself had mixed feelings about the (perceived) influence of the PI's presence on the interviews. On the one hand, it was extremely useful to be present as the PI could get a proper understanding of how the interviews were carried out. For the interviewers it was a reassurance and also stimulating to have the PI accompany them, as they could get feedback on their findings right away (and vice versa: the PI could directly ask questions or make comments). The villagers were in general friendly, gentle and hospitable. As the three study villages are all situated in ICDDR,B's *Comparison* area they have been involved in (international) research projects relatively less often. Foreigners thus attract a lot of attention. This had two consequences. Firstly it seemed to encourage the potential respondents to participate in the research (they felt proud to invite a foreign woman into their house), but secondly - and here the drawbacks come into the discussion - all the attention made it difficult for the interviewer to organise a private place where the interview could take place. In order to give the interviewer and the adolescent respondent some privacy, the PI therefore sometimes had to leave the house and find a place somewhere else to sit where she could 'chat' with the villagers (and thus keep them at a distance from the interview). After some time the attention generally evaporated and this enabled the PI to observe the interview again. As it was made clear right from the start of the interview why 'this foreign woman is present' (observing, wanting to learn something), but that she also 'does not understand any Bangla', the adolescent respondents did not seem to be bothered by the presence of the PI.

3.7.8 In-depth interviews

Although the survey data yielded an enormous amount of information about adolescents' reproductive health, there was a need to collect additional information that could not or hardly be collected by means of a survey, notably on perceptions about the menarche (adolescent girls and mothers), spermarche (adolescent boys), early marriage and childbearing (parents), and the meaning of adolescence (adolescents and parents). A total of six adolescent boys and twelve girls of whom were eight non-married and five married (we over-sampled married girls because they would, given their status, be able to tell us more about the consequences of 'late' menarche and reproductive health afterwards, notably the link with the first pregnancy

[41] In the baseline survey, anthropometry of 10 per cent of the children was taken the following day. No significant differences were found between the first and repeat measurement (Zaman et al. 1996, p. 310; Zaman et al. 1997, p. 924).

and childbirth), three fathers and five mothers were interviewed in-depth during the last weeks of the follow-up survey. In addition, some professionals working in the reproductive health and marriage domain were interviewed in order to learn about the socio-cultural context in which adolescent marriages are arranged: two *ghatoks*, or matchmakers, who are operating in the study villages, and one Family Welfare Visitor (FWV) from the study area under the *Farazikandi Union*. The *ghatoks* were interviewed about early marriage and were asked to sketch the process of matchmaking. The FWV was interviewed about her work and the services she provides for adolescent clients. Due to time constraints it was not feasible to interview a religious leader, as planned.

A female interviewer interviewed adolescent girls and mothers, while a male interviewer conducted the interviews with the selected adolescent boys, fathers and the key informants. The in-depth interviews were recorded. On one occasion, the respondent refused to allow the conversation to be recorded as she was afraid it was going to be used in an inappropriate way (inviting strangers or people from neighbouring villagers, who would recognise her voice, to listen to the tape and make fun of it). Unfortunately, during the fieldwork it became apparent that the quality of the recorders was poor, and as a result of this we could not fully transcribe the in-depth interviews but had to rely on notes made by the interviewers instead. The reports have been translated into English by a translator from Matlab and were later transcribed. We have to take into consideration the fact that the quality of the data collected in the in-depth interviews may be less than optimal (in other words, information may be lost or conveyed slightly differently) due to the two extra links (the interviewer and the translator) between the respondent and the researcher.

The topics selected for in-depth interviews (Appendix D) were based directly on the questionnaire of the follow-up survey. Unmarried and married adolescent girls, adolescent boys and their parents were asked to describe the concept of adolescence: what does it mean, what indicates its boundaries, and so on. After that the circumstances, experiences and feelings as related to menarche came up for discussion with adolescent girls and their mothers. Similarly, adolescent boys were interviewed about spermarche. This topic was, however, not discussed with fathers as it could have been considered disrespectful to discuss this topic with an older man. For all respondents, the interview went on to deal with sexual matters and their opinions.

Given our focus on the social connotation of timing of the menarche and in particular the possible influence of that to future events situated in the reproductive and marital career (see also Figure 2.2 in subsection 2.2.2), we asked the married adolescent girls a few questions about how they look back on the timing of their marriage in view of their age at menarche. The adolescents' fathers and mothers were also asked about their opinion with regard to the age of marriage of their son or daughter. This topic was embedded in a discussion about their own marital and fertility history (for fathers, the fertility history of their wives) in order to explore whether their own experiences with early marriage and childbearing may have impacted on the decisions they have to make (or have already made) with regard to the marriage of their children.

3.8 Conclusions and discussion

It goes without saying that the results of the analyses in the subsequent chapters rely greatly on the quality of the collected data. As has been described, several steps have been taken to guarantee the quality of the data. Reflecting on the whole period of fieldwork it can be concluded that solid foundations were laid, primarily by recruiting experienced and capable staff members. Both the FRO and the interviewers were selected by means of carefully planned procedures that involved among other criteria a written test and an interview. Except for one, all porters were living in the study villages, and this tremendously facilitated the process of tracing the selected adolescents, and also in persuading the respondents to participate in the study. Thanks to their efforts, knowledge and working spirit the week of training, the pilot survey and the regular survey interviews yielded the expected results. Furthermore, the expertise and co-operation of numerous experienced staff members of the Matlab Field Station and ICDDR,B Dhaka, including the translators and the typist who helped with the entry of all survey data, facilitated the smooth implementation of all fieldwork activities.

Apart from these ‘human capital’ influences, the quality of the data is believed to have profited from operational factors such as back-translating the questionnaire from Bangla into English in order to check the quality of the translation, the thorough discussion of the questionnaire with the ARH-team, the many spot-checks in which the PI and the FRO both accompanied interviewers while they were carrying out the interviews, and the ample time that was scheduled for the interviews - with two interviews scheduled per day there was no need to hurry through the interviews. On the contrary, there was plenty of time for small talk and making the adolescent respondent feel at ease, and this is believed to have improved the quality of both the survey and the in-depth interviews. Also the ten per cent ‘check interviews’ that were carried out among the adolescent population give us some insight into the quality of the information collected. Finally, by checking the data at various stages (instead of double-*entering*) the process of data entry is also believed to have been carried out adequately.

The fact that most of these adolescents were still living in villages that are situated in the *Comparison* area of Matlab is considered to be a positive factor, as these villagers (particular the adolescents) have not been interviewed before for studies other than Health and Demographic Surveillance System. For this reason, their responses may not have become ‘studied’ (knowing what answer needs to be given) or ‘social’ (knowing what answer is socially most acceptable) answers. Another positive aspect was the finding that adolescents often felt proud that an interviewer came especially for him or her (and not for his or her mother or baby brother or sister) and consequently displayed a lot of enthusiasm for the interview. It should be noted, though, that the very few adolescents who lived in villages situated in the Matlab *MCH-FP* area may therefore be relatively better off in terms of health and family planning facilities. However, it is also likely that cultural homogeneity is declining because of the influence of migration, spin-off effects such as occasional visits to their migrated family members in Dhaka for instance, and the introduction of mass media that facilitates the transmission and spread of knowledge. Also the presence of foreign researchers affiliated with ICDDR,B’s Field Research Station in Matlab and national and international NGOs operating in Matlab may have contributed to this development.

Next we will present the results of analyses. First a general demographic and socio-economic profile of the study population in early childhood and adolescence will be presented (Chapter 4). Then the adolescents' nutritional status career will be analysed (Chapter 5), followed by an assessment of the (observed and expected) timing of menarche (and, briefly, spermarche) in relation to the nutritional status career (Chapter 6). Following this, data on the adolescents' knowledge and perceptions of reproductive transitions and related topics relevant to reproductive development in adolescence will be analysed (Chapter 7). In this penultimate chapter the findings from the follow-up survey will be linked to results generated by the in-depth interviews.

4 Profile of the study population in early childhood and adolescence

4.1 Introduction

The aim of this chapter is to provide a demographic and socio-economic sketch of the study population in early childhood (section 4.2) and adolescence (section 4.3). We set forth both sections by describing *individual* characteristics of the study population such as age, sex, breastfeeding and vaccination status (in childhood only) and educational level (in adolescence only), followed by a sketch of the *household* in which the child, and adolescent respectively, is growing up. It should be noted that similar definitions of the concept of 'household' have been applied in the baseline and the follow-up surveys:

- At baseline: the group of individuals whose food is prepared in the same cooking unit (Baqui 1990, p. 56).
- At follow-up: persons eating from the same chula (hearth). We followed the definition provided by Amin (1998, p. 209) who has supplied clear distinctions concerning extended living arrangements, such as those found in rural Bangladesh.

The description of the *household* in which the child, adolescent respectively, is growing up merely reflects the household's *socio-economic* status. A household's socio-economic status is generally operationalised by a mixture of variables, such as the type of house and available amenities (number of rooms, materials of floor, roof and walls, type of toilet, type of fuels used, source of drinking water, etc.), the kind and number of household items and jewellery, and the number of livestock and size of land owned. In an area such as Matlab however, which is annually flooded as virtually the whole of Bangladesh, it is not the characteristics of the house as such that may be decisive for determining socio-economic status, but rather the location of the house. Houses that are built on the inside of the river embankment - a measure to escape the floods - have by far much better chances of remaining intact than those built outside or on the embankment. Households that can afford to buy (the more expensive) land on the inner side of the embankment generally do so, even if that means that they have for instance to cut down on costs of building materials for their houses. At first glance it may therefore look as if families living on the outer side of the embankment enjoy a better quality of housing - as their houses are more recently built and larger - than their counterparts who live, densely packed, in 'old' houses on the inner side the embankment. The scores on the socio-economic status indicators 'housing characteristics' and 'land size' may thus show just the opposite of a household's socio-economic status, as indexed by the variable reflecting a house's location relative to the river embankment.

In this chapter, we consider 'traditional' socio-economic variables as well as 'household ownership' and 'location of house' as (possible) reflections of a household's socio-economic status. The variables 'household ownership' and 'location of house' showed substantial intra-group variation whereas many of the 'traditional' variables appeared to show either little intra-group variation (for instance, type of latrine, fuels used, source of drinking water, electricity), can be less objectively interpreted in terms of 'higher' and 'lower' status (for instance occupation of the head of the household such as small businessman or farmer), or were very 'time-dependent' (for instance, income out of farming is subject to change over the year).

Because we aim to compare 'status' in early childhood with that in adolescence, the data that we analyse pertain to the *sample* of 562 (unmarried) individuals who were enrolled at baseline *and* selected for follow-up, i.e. those children who survived and who were living in the HDSS area between 1988-1989 and 2001. From the HDSS database (see subsection 3.7.7) we learned that 106 of the 707 under-five children who were enrolled in the baseline study could not be interviewed again in 2001 because they died or migrated out of Matlab, thereby dropping out from the HDSS and hence the possibility for follow-up. Of these 106 children, 11 were lost for follow-up because of death and 90 due to migration. We also analyse the characteristics of the deceased and migrated children on the basis of data from the baseline survey as well as data extracted from the HDSS database (section 4.4). The HDSS records the date and cause of death and migration respectively. In order to ascertain to the extent of the differences in deceased or migrated children in early childhood as opposed to the 'survivors and stayers', we studied the socio-economic status of the households in which these children grew up and their nutritional status[42] at baseline. Finally, conclusions of this chapter are discussed (section 4.5).

4.2 Study population in early childhood

Age and sex composition of the under-fives

Table 4.1 shows that most of the children who were surveyed in both waves were between 24 and 48 months old at baseline, in April 1988[43]. The age of those under-fives was calculated on the basis of date of birth (from HDSS) and date of interview in the baseline survey, both expressed in day/month/year. A large proportion of the children was younger than 1 year at baseline: 25 per cent was younger than 6 months and 9 per cent was between 6 and 12 months old.

Table 4.1 Distribution of study population by age and sex at baseline, Matlab 1988 (%)

Age (in months)	Boys (%)	Girls (%)	Total (%)	Sex ratio (M/F*100)
< 6	27	22	25	147
6-12	9	9	9	122
12-24	27	35	30	92
24-36	25	18	22	167
> 36	12	16	14	90
n	100 (n=307)	100 (n=255)	100 (n=562)	120

[42] The nutritional status of the 'survivors and stayers', i.e. the children who were enrolled at baseline in 1988-1989 and selected for follow-up in 2001, is analysed in Chapter 5.

[43] Initially one eligible child per household was selected (Baqui 1990, p. 56). However, in a later stage during the baseline survey additional under-five children were included of whom 65 of the 707 children belonged to families which already had one child enrolled in the survey (Baqui 1990, p. 57). We did not adjust the analyses for the (few) pairs of brothers and sisters.

Children who were 1 year old (between 12 to 24 months) and 2 years old (between 24 and 36 months) accounted for respectively 30 and 22 per cent. Only 14 per cent of the under-fives was older than three years (36 months or more). The mean age of under-five boys and girls was respectively 1.1 and 1.2 years.

We can also see that there were more boys than girls enrolled, i.e. 307 boys versus 225 girls. This surplus can be observed for almost all ages, except for the age group 12-24 months. The overall sex ratio (i.e. the number of boys per 100 girls) among the sample of individuals who were surveyed in both waves is 120. A similar sex ratio of 121 is observed in the total sample of the baseline population (not shown). The ratios differ however from that among 0 to 4-year-old children in Matlab according to two censuses that are nearest in time: the sex-ratio was 109 in the census of 1982 and 101 in the census of 1993 (Nahar et al. 1996, p. 36). At baseline, in April 1988, 50 per cent of the under-fives who were also followed up in the second wave, lived in *Saidkharkandi*. One-third of the study population, 33 per cent, lived in *Charmasua* and nearly 17 per cent in *Baluchar*.

Breastfeeding and vaccination status of the under-fives

Virtually the entire study population was breastfed. According to the mothers' recall in 2001, the under-fives were breastfed for 29.1 months on average. No differences were observed in this respect between the average figures pertaining to infant boys as compared to girls. Regarding vaccination status as assessed at baseline in 1988, it appeared that only 2 per cent of the 12 to 23-month-old under-fives, slightly more boys than girls, were *fully* vaccinated against DPT, polio, measles and BGG. Most under-five children, 91 per cent, had no history of measles; the remaining 9 per cent had measles in the past six months before the survey. In contrast, in Matlab in general, 60 per cent of the children aged 12 to 23 months were fully vaccinated (Ross et al. 1996, p. 13). Possibly, mothers or caregivers underreported the vaccinations received by their children. In addition, in the baseline survey the mothers or caregivers were asked whether their under-five child had received a vitamin A tablet in the last six months. Vitamin A is particularly important for the prevention of night blindness. Slightly more girls (69 per cent) than boys (66 per cent) received such a tablet recently.

Demographics of the household in which the child is growing up

In the remaining part of this subsection we discuss characteristics as measured at the household level. The majority of the under-fives, 99 per cent, were taken care of by their biological mother (n=562). For 6 children whose mothers had passed away, their grandmother or stepmother took care of them. Virtually all mothers[44] were married at the time of the baseline survey. Only 5 of them were divorced or widowed. The average age of the mothers at baseline was 29.2 years.

Relatively few children (4 per cent) were brought up by a mother who was still an adolescent (i.e. younger than 19 years) at the time of the baseline survey. The youngest mother at the baseline survey was 15 years. That the percentage of adolescent mothers is relatively low relates to the fact that maternal age is measured at

[44] Given that virtually all children were taken care of by their biological mother, for the remainder of this book we refer to 'mother' instead of 'mother or caregiver'.

the *moment of interview* (at baseline) and thus not at the moment of birth of the child under survey.

Most of the under-five children, 43 per cent, lived in households that comprised 4 to 6 members. Another 37 per cent of the children grew up in households consisting of 7 to 9 members at the time of baseline. The mean household size comprised 6.9 members, which is higher than the reported mean household size on in the HDSS *Comparison* area in the ICDDR,B's censuses of 1982 (5.9 members) and 1993 (5.6 members) (Nahar et al. 1996, p. 44). The baseline data do not provide information about household composition. The average number of live births to the mothers of under-five children was 4.2 at the time of baseline in 1988. Though a different measurement (given their age, the mothers of under-five children may not have completed their fertility career yet), this figure equals the national TFR in 1991 (BBS 1994, p. 28). Most households in Matlab consist of two or more generations. For instance, in the 1993 census of ICDDR,B the proportion of one-, two- and three-generation households in the HDSS *Comparison* area was respectively 4, 59 and 12 (Nahar et al. 1996, p. 27).

Religious affiliation of the household

All under-five children enrolled at baseline belonged to Muslim households. This is not different from expected, given the overall picture of religious affiliation in Bangladesh and Matlab. According to the ICDDR,B population census of 1993, in both parts of the HDSS area most people are Muslim (88 per cent), the remaining 13 per cent being virtually all Hindu (Nahar et al. 1996, p. 22). Between 1982 and 1993 the Hindu population as a percentage of the whole population declined from 15 to 13 (Nahar et al. 1996, p. 38).

Educational level of under-fives' parents within the household

The majority of the under-fives' parents was educated poorly or not at all educated as indexed by number of years of education (Table 4.2). Mothers were less educated than fathers were: 75 per cent of the mothers had no formal education, against 53 per cent of the fathers. Excluding the mothers and fathers without any years of formal education, the average number of years of education was 4.1 among mothers and 5.0 among fathers.

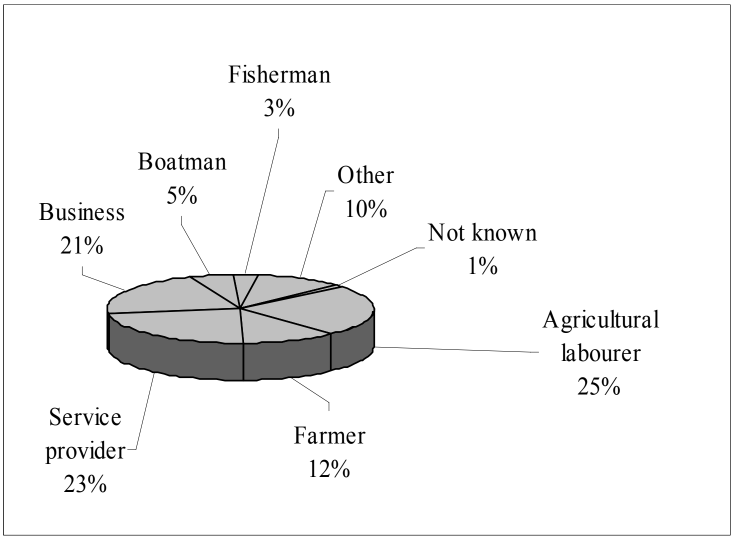
Table 4.2 Educational level of parents of under-five children at baseline, Matlab 1988 (%)

Years of education	Father (%)	Mother (%)
0	53	75
1-2	12	3
3-4	15	6
5-6	9	12
7-14	11	4
n	100 (n=562)	100 (n=562)

Occupation of heads of households

At the time of baseline in 1988 most households' heads (25 per cent) worked as an agricultural labourer, service provider (23 per cent) or as a (small) businessman (21 per cent). Other common occupations were that of farmer, boatman or fisherman (Figure 4.1). Household heads are generally an under-five's father, mother, grandfather or grandmother.

Figure 4.1: Distribution of household head's occupations at baseline, Matlab 1988 (%)



One may wonder how to classify these occupations according to (relatively) higher and lower socio-economic status. Recently, Marie Stopes International concluded a study conducted in Dhaka slums in which levels of household poverty grades were assessed according to several indicators on the basis of 'social mapping' (MSI 2003a, pp. 12-15). The latter involves definition and rating by the inhabitants of the slums themselves. With regard to jobs, an occupation such as labourer was ranked lowest and that of businessman highest. Given the urban location of the MSI study, occupations such as farmer, fisherman and boatman were not considered. In Matlab these last three occupations are generally ranked lowest whereas that of service provider is generally rated highest (i.e. relative within this group of occupations). The rating of the occupation of businessman depends wholly on the size of the business, but most businesses in rural Matlab are small scale.

Household income

At baseline, the average annual income per household was 20,064 *taka*. The average household income was a bit higher in *Charmasua* (20,345 *taka*) and *Baluchar* (20,391 *taka*) as compared to *Saidkharkandi* (19,767 *taka*). If the annual household incomes are considered relative to the size of the households, the average annual income amounts to 3,003 *taka* per member. It should be noted that this figure should not be interpreted as the average annual amount of money earned by each household member, but rather as the average annual amount available for each member, as not all household members are economically active or earning an income. Also, part of the household income may be received in kind, particularly when the members are engaged in agriculture. The volume of earnings in kind is not known. When broken down by village, the average annual income per household member (thus the amount of money available per member) was 2,883 *taka* in *Charmasua*, 3,056 *taka* in *Baluchar* and 3,183 *taka* in *Saidkharkandi*.

The socio-economic status of the household in which the under-five child grew up can also be determined from housing conditions, type of drinking water source, type of toilet, ownership of the house and land owned by the household. Virtually all (98 per cent) of the households in which the under-fives were growing up owned their house. Many households also owned a piece of land (88 per cent). In the baseline survey, no information was collected about the value or the size of the land owned. Almost 50 per cent of the houses had two bedrooms. A considerable proportion of the houses, nearly 37 per cent, had only one bedroom.

As can be read from Table 4.3, the walls of the houses were generally made of bamboo (39 per cent), jute (34 per cent) or tin (26 per cent) - a higher quality of building material and more expensive. Tin is also commonly used to roof the house. From Table 4.3, it is evident that more or less the same types of building materials are used in the three villages.

Table 4.3 Types of building materials of the houses in which the under-five children lived, by village at baseline, Matlab 1988 (%)

Part of house	Building materials	Charmasua (%)	Saidkharkandi (%)	Baluchor (%)	Total (%)
Walls	(Brick) pucca or cement	0	1	0	0
	Bamboo	37	41	38	39
	Straw	1	1	0	1
	Tin	28	24	29	26
	Jute	34	33	33	34
	Others	0	0	0	0
	n	100 (n=187)	100 (n=281)	100 (n=94)	100 (n=562)
Roof	Straw	6	0	3	3
	Leaves	4	5	5	5
	Tin	90	95	92	92
	n	100 (n=187)	100 (n=281)	100 (n=94)	100 (n=562)

The houses in the study villages are generally built in groups of three to ten around a main courtyard, the *bari*. Relatives living around such a *bari* often also share for instance a drinking water source and take baths in the same pond. More than two-thirds of the households (71 per cent) did not have a tube well in the courtyard. The rest of the households had a water supply close to the house, although the tube wells of 7 per cent of this group failed to work properly. The distance to the nearest drinking water source was on average about 185 feet, whereas water needed for washing, cooking and bathing purposes was to be found at an average distance of 103, 125 and 133 feet, respectively. Virtually all households, 97 per cent, owned a latrine. A *kuccha* (hole in the ground) type of toilet was hardly used.

Most of the houses in *Charmasua*, over 71 per cent, were situated on the relatively less secure side of the river embankment, whereas in *Baluchar* 39 per cent of the houses was built outside the river embankment. *Saidkharkandi* is situated completely inside the river embankment. In order to examine how the indicators of socio-economic status discussed so far relate to each other, we cross-tabulated in Table 4.4 the household's economic status, indexed by five quintiles of *income* ranging from the poorest 20 per cent to the richest 20 per cent, with the variables on land ownership, number of rooms, material used for the walls, tube well, and finally, the location of the house relative to the river embankment.

Table 4.4 Economic status of the households to which the under-five children belonged, according to income and socio-economic indicators at baseline, Matlab 1988 (%)

		Income					
Socio-economic indicators		**Poorest 20%**	**Second quintile**	**Middle group**	**Fourth quintile**	**Richest 20%**	**Total %**
Land owning	Yes	77	87	82	94	95	88
	No	23	13	18	6	5	12
Working tube well in yard	Yes	25	28	27	28	36	29
	No	75	72	73	72	64	71
Number of rooms	One room	58	58	36	29	11	37
	Two or more rooms	42	42	64	71	89	63
Material of walls	Jute	50	43	33	31	14	33
	Bamboo	40	40	45	44	27	39
	Tin	9	15	21	24	58	26
	Other	1	2	1	1	1	2
Location of the house	Within embankment	75	71	66	67	71	70
	Outside embankment	25	29	34	33	29	30
	n	100 (n=111)	100 (n=89)	100 (=85)	100 (n=163)	100 (n=114)	100 (n=562)

In general, Table 4.4 shows that greater financial means correspond with a greater likelihood of living in a house which is owned, containing two or more rooms, and made of higher-quality building materials, such as tin in contrast to bamboo and jute, as well as having a tube well in the yard. For instance, the proportion of households that owns any land is highest among the richest quintile (95 per cent) and lowest, though still relatively high, among the poorest quintile (77 per cent). In addition, the richer households are more likely to live in larger houses, indicated by the number of bedrooms, than the poorer households (89 against 42 per cent). The last factor, location of the house relative to river embankment, is less ambiguous in its relation to household income and the other socio-economic indicators.

As outlined in section 4.1, it could be assumed that households that can afford to buy (the more expensive) land inside the embankment generally do so, even if that means that they have for instance to cut down on costs of building materials for their houses. The scores on the other socio-economic status indicators may thus show just the opposite of a household's socio-economic status as indexed by the variable on a house's location relative to the river embankment. The baseline data do not entirely corroborate with this notion. Households that are most likely to live within the river embankment are found among the poorest 20 quintile (75 per cent), followed by the richest 20 quintile of the households (71 per cent). The difference with the three categories of households that earn average income, is however not large (respectively 71, 66 and 67 per cent for the second, middle and fourth quintiles of income). Possibly, the richest households are not only able to afford a house on the safe side of the river embankment but also have enough financial means to spend money on their house as well (as reflected by a larger house and the use of higher-quality building materials), whereas the poorest households may be poor because they allocated all of their money on a house situated within the river embankment, thereby indeed compromising on the quality of building materials for the house.

In Table 4.4, households in all three villages have been taken into account. It should be noted that *Saidkharkandi* is located completely within the river embankment. When we run the same cross-tabulation on the basis of households living in *Charmasua* and *Baluchar* only, we find for each socio-economic indicator a similar pattern in terms of distribution over the respective quintiles of household income. Regarding the proportions of households living within the river embankment, we find again the highest figures among the poorest (42 per cent) and richest (45 per cent) quintiles of the households.

4.3 Study population in adolescence

Age and sex composition

At the time of the follow-up survey in 2001, the adolescents varied in age between 12 and 16 years (Table 4.5). The mean age of the adolescent study population is 14.0 years, for both adolescent boys and girls. Naturally, the overall sex distribution within the study population remained the same as it was 13 years ago: 120 boys to every 100 girls. However, across the ages, the sex ratios differ considerably. Within the study population, there is a surplus of female adolescents at the ages 12, 14 and 16 years, whereas male adolescents form by far the majority at the ages 13 and 15 years.

Table 4.5 Distribution of study population by age and sex at follow-up, Matlab 2001 (%)

Age (in years)	Boys (%)	Girls (%)	Total (%)	Sex ratio (M/F*100)
12	12	16	14	93
13	26	15	22	195
14	26	36	30	87
15	26	18	22	176
16	10	15	12	84
n	100 (n=307)	100 (n=255)	100 (n=562)	120

As compared to the situation at baseline, the sex distribution per age in adolescence has changed. This is related to the fact that data collected about an individual in the second wave of 2001 did not (if it did, it was by chance) take place on the same day as when data were collected about the same individual in the first wave of 1988. The under-five child's age at baseline is based on his or her age at first measurement, or if the first measurement was missing, on his or her age at the first measurement available. During the follow-up survey, adolescents' ages depended on the date of interview (as it was calculated on the basis of date at birth as provided by HDSS and date of interview, expressed in day/month/year). The actual period of data collection took about three months. Consequently, the age distribution of the study population during adolescence, expressed in percentages of the totals per sex, shows a different picture as compared to the distribution in early childhood, although the study population in both waves consists of the same individuals.

The distribution of the study population across the three study villages has slightly changed as compared to the situation at baseline. As indicated in Table 4.6, the majority of the adolescents (49 per cent) lives in *Saidkharkandi*, followed by *Charmasua* (30 per cent) and *Baluchar* (16 per cent). A small proportion of the study population, 5 per cent or 26 individuals, has migrated internally, thus within the Matlab *thana* to other villages. Within the group of adolescents who moved to one of these neighbouring villages, 54 per cent were males as opposed to 47 per cent females.

Table 4.6 Distribution of study population by age and village at follow-up, Matlab 2001 (%)

Age (in years)	Charmasua %	Saidkharkandi %	Baluchor %	Other village %	Total %
12	4	6	3	1	14
13	6	11	3	2	22
14	9	15	5	1	30
15	7	11	3	1	22
16	4	6	2	0	12
n	30 (n=170)	49 (n=274)	16 (n=92)	5 (n=26)	100 (n=562)

All the neighbouring villages are near to the three main study villages and can therefore be considered similar in terms of environmental or socio-economic conditions. Only three of the neighbouring villages (*Nabakalash*, *Digholdi*, and *Mobarakdi*) are situated in ICDDR,B's *MCH-FP* area (Block A), and may therefore be relatively better off in terms of health and family planning facilities (see als section 3.5).

Validation of reported age

The adolescents' age was calculated from the date of visit and date of birth as provided by HDSS, both expressed by day/month/year. However, we also asked the adolescents themselves how old they were at the time of the follow-up survey. Table 4.7 shows the consistency between the age as calculated on the basis of the respective dates from the survey (interview date) and HDSS (date of birth) and the adolescent's self-reported age. The numbers that reflect consistency between the two ages are in bold font.

Table 4.7 Validation of age*: age according to HDSS and self-reported age of adolescents, Matlab 2001

Self-reported age (in years)	Age calculated on basis of HDSS (in years) 12	13	14	15	16	Total
<=10	15	7	8	0	0	30
11	5	3	2	1	1	12
12	**36**	40	29	12	1	118
13	16	**39**	43	7	4	109
14	1	15	**44**	30	7	97
15	0	2	17	**42**	14	75
16	0	0	4	13	**15**	32
>=17	1	0	0	0	11	12
Don't know	0	0	1	0	0	1
n	74	106	148	106	53	487

* Absolute numbers. Excluding reports of proxy persons

Assuming that the HDSS data on date of birth are correct, we have to conclude from Table 4.7 that a considerable number of the adolescents do not know his or her age (note that this table is based on what adolescents reported; reports of proxy persons have been excluded). If we consider a self-reported age of one year below or above the age in years as calculated on the basis of HDSS still as 'accurate', it appears that 22 per cent of the adolescents does not know his or her correct age. However, if weconsider only those self-reported ages which are concur with the age as calculated on the basis of HDSS as 'accurate', no less than 63 per cent of the adolescents under- or over-estimated his or her age. In general most adolescents underreport their age, i.e. they say that they are younger than they actually are, i.e. according to HDSS. It should be stressed that for the analyses we did not make use of the self-reported age of the adolescents but we deduced their age on the basis of the date at birth as provided by HDSS and the date at interview.

It should be noted that the data of 487 individuals were included in Table 4.7, which is lower than the 562 records that were selected for follow-up. The lower number of cases is due to the fact that (as outlined in subsection 3.7.7) not all adolescents who were selected for follow-up could be interviewed, and in the case of the adolescent respondents who could not be interviewed, on some occasions information was collected from proxy persons. In general, of the 562 adolescents, 84 per cent (which equals to 470 individuals) has been interviewed at follow-up (see subsection 3.7.7). The analyses discussed hereafter are based on these 470 records, plus - if possible - additional records completed by proxy persons. However, not all data could be collected from proxy persons (it is for instance easier for a proxy person to give information about the house in which the adolescent lives than to provide information about the adolescent's number of years of completed education. Consequently, the number of cases may differ pending the topic of analysis (varying from for instance 223 adolescent girls reporting about their future educational ambitions to 553 adolescents and proxy persons reporting about the household's possessions).

Adolescents' religious engagement

As noted in subsection 3.8.1, the study population are Muslims. In order to gain insight into the role religion plays in the lives of the adolescents, we asked them about the number of visits to the mosque. The majority of the interviewed adolescents (n=487), 75 per cent, does not visit the mosque very often on a daily basis. However, of the adolescent boys 24 per cent visits the mosque at least three times per day, as compared to 11 per cent of the adolescent girls. Only a negligible number of boys (2 per cent) and 8 per cent of the adolescent girls never visit the mosque. The role of religion may also influence the type of school attended, which is our next topic of discussion.

Adolescents' educational level

There is a primary school in all three villages (year 1 to 5), and a secondary school is located in *Charmasua* (year 6 to 10). School enrolment ('ever visited a school') among the adolescents (n=488) is high: 98 per cent (broken down by sex, respectively 96 per cent among boys and 99 per cent among girls). No differences were observed among the study villages with regard to school enrolment of the study population in adolescence. Among the sample, 6 boys went to a *madrasha* where the Koran is taught. Excluding these boys, the average length of education completed is 4.5 years for boys. Remarkably, on average, girls attend school for a comparable longer period: 4.7 years. Primary education (year 1 to 5) was obtained by 69 per cent (71 per cent of the boys and 68 per cent of the girls). Reasons given for not ever having attended school (only 2 per cent of the adolescents) were a lack of financial means, a need to work, no interest in school, or - as mentioned by a few - 'being a failure'.

Most of the 476 interviewed adolescents were still attending school then: respectively 80 per cent of the adolescent boys and 90 per cent of the adolescent girls. School is very popular among adolescent girls: 80 per cent of the girls were positive in response to the question whether they are interested in the subjects they studied at school. This proportion is much lower among adolescent boys, i.e. 56 per cent. Current school attendance also hardly differs across the three main study villages. Among the adolescents who used to attend school but dropped out (n=72), the most common reasons cited were that they did not like school or were not interested (32 per cent, mainly boys), could no longer afford it (25 per cent), had to work or help in the household (21 per cent, mainly boys), viewed themselves as 'failures' (8 per cent, all boys), or because of 'family reason' (7 per cent). The reaching of menarche and a prospective marriage were reasons for 2 adolescent girls to quit school. A special group of adolescent boys (n=18) quit or was planning to quit formal education to pursue studying the Koran at a *madrasha*.

We also inquired about the adolescents' future educational ambitions. No less than 54 per cent of the interviewed adolescent girls (n=223) wanted to complete secondary school, whereas 29 per cent aimed to complete their educational career with a college degree and 8 per cent did not think that they would proceed further than primary education. University is generally believed to be out of reach for all but 3 per cent of the adolescent girls. A similar proportion of the girls (2 per cent) held no educational ambitions at all or did not have an opinion about this (4 per cent). Among the interviewed adolescent boys (n=260), 15 per cent had no educational ambitions and 6 per cent aimed to complete primary school at the most. A considerable group of boys, respectively 27 and 28 per cent, were hopeful of obtaining secondary school certificate or a college degree, and over one-fifth, 22 per cent, saw themselves with an university degree. The other boys did not have an idea about the course of their educational career (2 per cent).

In the 1996 Socio-Economic Census of ICDDR,B 40 per cent was illiterate in the *Comparison* area (which is similar to that in the *MCH-FP* area) (Razzaque et al. 1998, p. 15). Over time, and also reflected by our results, the difference between the sexes with regard to educational enrolment and level is narrowing. To date there is no longer a difference by gender in the school-aged population (Razzaque et al. 1998, p. 1). The Bangladesh government and NGOs have put in a lot of effort into educational development of girls, as reflected in our results. Special ‘food for education’ programmes may have contributed further towards the increased educational prospects of young children.

Related to this, if we recall that 75 and 53 per cent of under-fives’ mothers and fathers had no formal education (see section 3.8.1) and contrast them with the aforementioned figures on school enrolment and proportion of adolescents having completed primary school (69 per cent), our data also clearly illustrate that the increase in educational attainment over the generations has been considerable. The observed increase in basic education when comparing mothers with children is confirmed by Bangladeshi national statistics: in 1993-1994 there were 23 per cent women with 7 or more years of schooling among 15 to 19-year-old girls and 7 per cent among 40 to 44-year-old women (TAGI 1998, pp. 48-49).

Adolescents’ occupations

The adolescents’ educational career may run parallel to their working career (see also subsection 2.2.2), which may also start at a young age. According to ICDDR,B’s instruction for fieldworkers engaged in collecting data on occupation in the 1996 Socio-Economic Census, information on occupations is collected for individuals aged 8 years and older (Razzaque et al. 1998, p. 65). As already indicated, some of the 12 to 16-year-old adolescents left school in order to work, whereas others combine school with a job[45]. Only 4 per cent - among which include 80 per cent girls - of the adolescents (n=476) neither goes to school nor has a job at the time of the follow-up survey. It appeared that 13 per cent - among which include 86 per cent boys - of the adolescents (n=487) currently has a job. The majority of the adolescent boys and girls (87 per cent) combines this with school. The most common jobs were agricultural labourer or farmer (33 per cent; only boys), vendor or employed in small business (24 per cent; only boys), engaged in household work (13 per cent; only girls), fisherman (10 per cent, only boys) and carpenter (6 per cent; only boys).

Among the adolescents with a job, 11 per cent also holds a second job, which were all in the agricultural sector. The adolescents work on average 7.8 hours per day. When broken down by sex, it appears that boys report working on average 8.3 and girls 4.9 hours per day. Not all adolescents who work also receive an income from that: 30 per cent receives no remuneration (among which include 56 per cent boys). Those who do get paid earn an average monthly income of about 1307 *taka*.

[45] The concept of ‘job’ was not defined beforehand. The adolescent respondent was asked whether he or she had an occupation (main and second occupation), and if so, how many hours per day he or she worked. Adolescents did in general not consider household work as a ‘job’ or occupation (only 8 girls reported this as their job). However, when the adolescents were asked about what they generally do when they are not going to school or working, 75 per cent reported to be engaged in activities related to household chores (cooking, collecting fuels, collecting water, other domestic work) or helping father or mother. These activities are apparently not perceived by the adolescents as ‘work’ but as something they do in their free time.

We also inquired about the career ambitions of the adolescents. Boys (n=260) picture themselves working in a factory (21 per cent), in business or sales (19 per cent), in an office (13 per cent), teaching at a school or mosque (11 per cent), as a doctor (10 per cent), abroad (7 per cent) or in the agricultural sector (7 per cent). The remaining group of boys has different plans (11 per cent) or they do not know yet about what kind of work to do in the future (1 per cent). Adolescent girls (n=223) expect to work as a housewife (34 per cent), teacher (18 per cent), health-worker (16 per cent), tailor, handicraft or garment worker (15 per cent) or doctor (7 per cent). The other girls have other plans (7 per cent) or do not have an idea yet about a career (3 per cent). A considerable proportion of the adolescent boys, 50 per cent, and 10 per cent of the adolescent girls do not expect to remain in their village. Dhaka is by far the most popular magnet: no less than 71 per cent of the boys and 78 of the girls with migration intentions expect to migrate to the capital. Another 15 per cent of the boys expects to migrate abroad. How much value we should attach to these (snapshot) 'intentions' remains to be seen: migration generally does not take place at these young ages and plans in this direction are subject to change over time.

Demographics of the household in which the adolescent is growing up

The adolescents enrolled in the follow-up survey (n=487) lived in households together with their father (83 per cent), mother (98 per cent), one or more brothers (88 per cent), one or more sisters (78 per cent), grandmother (13 per cent), grandfather (3 per cent), one or more sisters-in-law (12 per cent), other family members' children (11 per cent), and in some cases with other relatives, among whom include their aunts and uncles (8 per cent). The average number of household members is 6.4, with a minimum of 2 and a maximum of 16.

Educational level of adolescents' parents

As described in subsection 3.8.1, we already learned from the baseline survey that 75 per cent of the mothers and 53 per cent of the fathers had no formal education. In the follow-up survey we also asked the adolescent respondents to report about their parents' educational level. Though we might expect some differences between the results based on the adolescents' reports and the baseline information, basically both results should not differ considerably. Differences may relate to the fact that we do not have reports on parental educational level of *all* adolescents, and that, in theory, parents may have gained an additional few years of education after the moment of interview at baseline. Analyses reveals that whereas 75 per cent of mothers had not completed any years of formal education according to the baseline data set, a figure of 46 per cent was derived from interviews with the adolescents (n=505 in follow-up data set). Correspondingly, the respective figures on fathers' educational level are 53 per cent versus 29 per cent (n=473 in follow-up data set). Adolescents rate the educational level of their parents higher than that reported by their mothers or fathers at baseline and, apparently, some are not aware that their father or mother is not educated.

Special social positions

Not only do socio-economic indicators such as (parental) educational level or occupation directly or indirectly affect a child's or adolescent's nutritional status or reproductive knowledge and perceptions, but also a special social status of the household may carry certain advantages with it (for instance a transfer of specific knowledge, a glimpse of a broader world or privileges). We asked the adolescents (and proxy persons) whether any of the members of the household to which they belong holds a special social position in the village. The answers to this question were partly pre-coded but not read out loud, to allow them to express their own idea of what is special in terms of social status. It appeared that 16 per cent of the adolescents (n=505; 49 proxy persons are excluded) considers their household ‘special’, which is mainly ascribed to one of its members being a UP (*Union Parishad*) or local leader (38 per cent), a teacher (18 per cent), a nutritionist or Family Planning worker (9 per cent), a local politician (9 per cent) or a midwife (9 per cent). The remaining special positions mentioned were that of a traditional healer (6 per cent), NGO worker (6 per cent), religious leader (4 per cent), and *ghatok* or matchmaker (2 per cent).

Household’s land and possessions

Virtually all adolescents belong to households that live in owner-occupied houses (97 per cent; n=553). A similar proportion of the households, 98 per cent, also owns land, such as the homestead land or ploughing land. In most of the cases, 80 per cent, it is the adolescent’s father who owns the land. In the remaining cases the grandfather or other family members are the owner. The land is owned by the adolescent’s mother in only 2 per cent of the cases, mainly in *Saidkharkandi*. Ownership of house or land as such is thus not a marker of socio-economic status. Therefore we also inquired in the follow-up survey about the estimated value of the owned land by asking how much it would cost on the current market. As was expected, not all adolescents or proxy persons were able to make such estimation. Among the ones who were able to make such an estimation (73 per cent), the mean value of the land was estimated to be 147,047 *taka,* which equals to about 3,342 *euro* (n=396).

Among the items[46] and animals owned by most of the households are a wooden bed (94 per cent), a watch or a clock (67 per cent), an *almira* (cupboard) (64 per cent), a radio (43 per cent), chicken (92 per cent) and a cow, buffalo or goat (60 per cent). Less common possessions are a boat (20 per cent), bicycle (11 per cent), television (6 per cent), generator or tractor (3 per cent), rickshaw (3 per cent), sewing machine (3 per cent), electric fan (2 per cent), ‘*baby taxi*’ (1 per cent) and telephone (less than 1 per cent).

Most houses of the adolescents’ families are relatively small: almost 9 per cent lives with the whole household (*ghar*) in one room, 42 per cent lives in two-room houses, 34 per cent in three-room houses and a minority of 16 per cent live in houses with four to seven rooms. Because of the relative simplicity of the houses, the main room in the house generally functions both as living room and bedroom. If there are more rooms available, children often sleep together in one room, whereas the parents and the youngest children sleep in the other room. Sometimes the kitchen is located under

[46] We also asked whether the adolescents owned any jewellery or gold accessories. The majority (over 82 per cent) responded in the negative. Among the adolescents who do own these valuables, 84 per cent are female. Jewellery and gold items are generally used as part of a dowry and if households can afford it they will start building up a dowry for their daughter as soon as possible. With jewellery a Bangladeshi woman shows her wealth. In contrast to the value of land owned, there is much more knowledge about the worth of the jewellery owned. Excluding a few exceptionally high estimates, the adolescents estimated that their jewellery and gold items are on average worth 2,625 taka or 60 euro.

the same roof but it is also quite common that households belonging to one *bari* share a kitchen, which is built outside the house. Table 4.8 shows that there is hardly any difference across the study villages with regard to type of flooring in the respondents' bedroom (which thus also generally functions as living room): virtually all adolescents, 99 per cent, sleep in a room with a mud floor covered by leaves or straw (n=553). The walls are commonly made of bamboo (48 per cent) or tin (47 per cent). The material used for roofing the house is tin (99 per cent). As compared to the situation in childhood, indicated by the analyses of baseline data (section 4.2), tin as a material used for walls has gained in importance. Tin owes its popularity to its practicability and solidity. The increase in the use of tin instead of bamboo and jute, may indicate that over time the socio-economic conditions of the households have improved.

Table 4.8 Types of building materials of the houses in which the adolesents live, by village at follow-up, Matlab 2001 (%)

Part of house	Building materials	Charmasua (%)	Saidkharkandi (%)	Baluchor (%)	Other villages (%)	Total (%)
Floor	Leaves/ straw (on mud)	100	99	97	96	99
	Other materials	0	1	3	4	1
	n	100 (n=168)	100 (n=266)	100 (n=93)	100 (n=26)	100 (n=553)
Walls	Bamboo	39	50	55	50	48
	Tin	60	41	42	46	47
	Other materials	1	9	3	4	5
	n	100 (n=168)	100 (n=266)	100 (n=93)	100 (n=26)	100 (n=553)
Roof	Tin	100	99	100	96	99
	Other materials	0	1	0	4	1
	n	100 (n=168)	100 (n=266)	100 (n=93)	100 (n=26)	100 (n=553)

For years, tube wells have been promoted as the safest[47] source of drinking water in Bangladesh. In our study villages, 97 per cent of the households in which the sampled adolescents live pump water from a tube well for drinking purposes. Over one-third of these tube wells (37 per cent) is owned by the household that uses it. About half of the tube wells (44 per cent) is located outside the *bari*. These are mostly the tube wells that are not owned by the household. Water from ponds or canals is no longer used for drinking but it is still important for bathing and washing. Only 4 per cent of the households from the neighbouring villages (i.e. a study village other than *Charmasua*, *Saidkharkandi* or *Baluchar*) have tap or piped water supply.

Regarding sanitation, almost 39 per cent of the adolescents' households uses a *kuccha* toilet, a hole in the field. This is a considerably higher percentage as compared to that at baseline, when it was negligible. In *Baluchar* and the neighbouring villages, this type is used by half of the respondents' households. The second most used type of toilet is the pit latrine (owned by 25 per cent), whereas another 18 per cent of the households shares a pit latrine. Interestingly, in contrast to the situation at baseline, 18 per cent of the households makes use of a sanitary latrine or septic tank, which is

[47] Water from wells might not be as safe as believed. In 1993 arsenic contamination in groundwater was discovered in Bangladesh at a scale which is in terms of population exposure was the most serious in the world. For example, 94 per cent of the wells were contaminated in a thana of Chandpur District. Arsenic poisoning causes skin diseases, cancer and death. It is estimated that 95 per cent of the population in Bangladesh uses groundwater for drinking (Britisch Geological Survey 2004).

owned or shared with other households. This development may also reflect an increase in socio-economic development.

Sources of fuels

Finally, another insightful marker reflecting the households' socio-economic position is the access to electricity. Very few (1 per cent) of the adolescents live in households with electricity. This proportion is lower as compared to national statistics: 17 per cent of the 15 to 19-year-old girls for instance live in homes with electricity in Bangladesh (1993-1994) (TAGI 1998, pp. 48-49). For cooking, most of the households use a mixture of fuels. The most important fuel material is wood, which is used by 94 per cent of the households (n=553). Virtually all of these households (98 per cent) also use an additional fuel material such as straw, jute, rice husks, leaves or cow dung.

4.4 Children lost for follow-up due to death or migration

Lost for follow-up due to death

As shown in Table 3.3 (subsection 3.7.7), 11 children died before the follow-up survey. The 11 children who died were living at the time of baseline in *Charmasua* (5 children) and *Saidkharkandi* (6 children). Given the focus of our research, our aim is to examine the extent to which the nutritional status of these children was already less adequate, and, probably related, whether they were living in households that were relatively poor or characterised by less favourable living conditions, as compared to their counterparts in the follow-up survey.

From the HDSS database we extracted the data pertaining to these children's cause and date of death. Cause-of-death analyses by age reveals that among the few children who died - 7 boys and 4 girls - most did not reach the age of five years. Boys were on average 46.4 months old when they died, the youngest boy being 2 months and the eldest boy being 138 months (or 11.5 years) at the time of death. The 4 girls who passed away were on average 36.0 months old when they died, the youngest and eldest girl being respectively 12 and 60 months (or 5.0 years) old at the time of death. It should be noted that the relatively low number of deaths is probably related to the fact that 64 per cent of the total baseline population (i.e. the 707 children) were already older than one year at the onset of the baseline survey, and hence, had passed the critical[48] first 12 months of life.

From Table 4.9 we see that most causes of death are associated with malnutrition, diarrhoea (including shigellae and dysentery) or both. Respiratory infections and drowning are furthermore factors that have led to a premature ending of the lives of some children. Of the 11 deceased children, 4 died in the hot and dry season (April to June) and 5 died in the monsoon season (July to September). None of these children appeared to have had any of the four types of immunisation (DPT, polio, measles and

[48] 'Critical' in the sense that, apart from the ages of 70 years and older, death rates (per 1000 of population) are never higher than in the first year of life in Matlab. For instance, in 2000 the death rate in this area was 51.6 for children under 1 year (and 38.4 for children under 1 month), 5.2 for children between 1 and 4 years, and 55.4 for adults of 70 to 74 years (and higher for the 75 and older population) (ICDDR,B 2002a, p. 29).

BCG), whereas 7 of the 11 children did receive a vitamin A tablet within six months prior to the baseline survey.

Table 4.9 Children lost for follow-up: absolute number of deceased children by cause of death according to HDSS and sex, Matlab 1988-1999

Cause of death	Boys	Girls	Total
Measles	0	1	1
Post-measles dysentery	0	1	1
Shigellae	1	0	1
Severe malnutrition associated with chronic diarrhoea	2	0	2
Marasmus due to other chronic infection (non-diarrhoea)	1	0	1
Pneumonia, acute lower respiratory infection	1	1	2
Respiratory infection	0	1	1
Drowning	2	0	2
n	7	4	11

Lost for follow-up due to migration

Of 95 out of the 99 under-five children who were lost for follow-up because they have moved out of the HDSS area between the two survey rounds, the HDSS data files provided us with information about the date and reason for migration. Table 4.10 shows that more than three-quarters (76 per cent) of the children who migrated, did so with their family. Because of their young age, it is likely that the children who migrated did so with their parents or other household members. Of the girls, 24 per cent were 12 years or older at the time of migration and these girls may have possibly migrated because of marriage (to join their spouse). Other important reasons to migrate from the Matlab area were a new job and - for boys only - education and training. At baseline, 57 per cent of the children who later migrated lived in *Saidkharkandi*, 25 per cent in *Charmasua*, and 18 per cent in *Baluchar*.

Table 4.10 Children lost for follow-up: distribution of migrated children by reason for migration according to HDSS and sex, Matlab 1988-1999 (%)

Reason for migration	Boys (%)	Girls (%)	Total (%)
Family feud or dispute	2	0	1
Adoption	0	3	1
To take up a new job	15	7	12
Business opportunity	4	0	2
For education or training	9	0	5
Follow spouse, parent, guardian or relative	66	87	76
River erosion	0	3	1
Other reasons	4	0	2
n	100 (n=55)	100 (n=40)	100 (n=95)

Profile of the children who died or migrated as compared to those children who were followed up in 2001

Table 4.11 (page 114) presents an overview of various demographic and socio-economic indicators for each group of under-five children at baseline. The scores pertaining to the group of under-five children who later passed away and the group of under-five children who later migrated out of the HDSS area are contrasted with the scores for under-five children who survived and remained living in Matlab up to the onset of the follow-up survey (as discussed in subsection 3.8.1).

Regarding the demographic statistics hardly any differences were observed between the groups at the moment of baseline, in 1988. The only variable that stands out is the age of the under-fives' mothers. The average age is higher for mothers of children who later passed away as compared to that of mothers of children who survived and remained living in the Matlab area up the onset of the follow-up study (35.1 versus 29.2 years). Despite their higher average age, among the group of mothers whose child later passed away, the average number of live births is lower. Conclusions cannot be derived on the basis of this table. Apart from the small number of cases (n=11), we lack for instance information on the number of children ever born, which would indicate to what extent under-five mortality is higher among high-parity mothers as opposed to low-parity mothers, and which would enable us to explore to what extent parity, maternal age, and number of live births interrelate and possibly influence under-five mortality. In earlier research conducted in Matlab, it was found that mortality rates are over five times higher for children of mothers with no education as compared to those having seven or more years of schooling (D'Souza et al. 1980, p. 22). Given the low number of cases, our data do not allow for a conclusion.

Disregarding - because of the low numbers - the lower percentage of uneducated fathers of the same under-five children who later passed away, the only socio-economic indicator that stands out is the percentage of households who owned land at baseline. This proportion is lower (74 per cent) among the households of children who later migrated as compared to the households of children who remained in the HDSS area (88 per cent). Possibly, households that later migrated were inclined to do so because they did not have any land of their own.

The scores on the remaining indicators of socio-economic status show no appreciable differences across the three groups of under-five children. It could be hypothesised that particularly poor households or, at the other end of the spectrum, the relatively richer households and higher educated parents, are more inclined to migrate, whereby one could contend that migration is respectively poverty-driven or realisable for those with financial means, and possibly more opportunities in terms of higher-skilled jobs. However, the results obtained from this brief comparative sketch do not corroborate this notion.

Table 4.11 **Demographic and socio-economic characteristics of the households of the under-five children at baseline: those who were lost for follow-up due to death or migration versus those who were enrolled in the follow-up survey, Matlab 1988**

Characteristics of under-fives at baseline		Among children lost for follow-up: death	Among children lost for follow-up: migration	Among children in follow-up study
Demographics of household	% of mothers married	100	100	99
	Mean age of mother (years)	35.1	28.4	29.2
	% of children brought up by adolescent mother	0	5	4
	Average number of live births of mother	3.6	3.9	4.2
	Mean household size (number)	6.2	6.5	6.9
	% of children living in household comprising 7 members or more	27	50	51
	% of children from Muslim households	100	100	100
Socio-economic status of household	% of mothers without formal education	73	74	75
	% of fathers without formal education	46	53	53
	% of fathers in business	9	21	21
	Average annual household income (*taka*)	20,791	19,037	20,064
	% of households with own land	91	74	88
	% of households living in house with one room	27	47	37
	% of households living in house with tin wall	18	20	26
	% of households with working tube well	27	23	29
	n	11	95	562

Nutritional profile of the deceased and migrated
In Table 4.12 we take a brief look at the following Chapter 5, in which we study nutritional status of the study population in childhood and adolescence. In this subsection we explore on the basis of a selection of key anthropometric indicators, the nutritional status of under-fives who later passed away and that of under-fives who later migrated out of the Matlab area before the follow-up survey. Their nutritional status at baseline is contrasted with that of the under-five children who survived and remained living in the Matlab area and who were successfully interviewed in the follow-up survey in 2001. From the earlier discussed cause-of-death analyses we learned that the cause of death of most children who were lost for follow-up was attributed or associated with malnutrition. We are therefore particularly interested in exploring whether the nutritional status of children who died later on was already less adequate vis-à-vis their surviving counterparts who were followed up in 2001. It should be noted that the results should be interpreted with care because of the small number of children who passed away and their known nutritional status at baseline (10 out of the 11 children).

Table 4.12 Nutritional status of the under-five children at baseline: those who were lost for follow-up due to death or migration versus those who were enrolled in the follow-up survey, Matlab 1988

Nutritional status indicators*	Age (in months)	Lost for follow-up due to: death**	migration	Enrolled in follow-up
Weight (in kg)	0-12	5.7	5.5	5.3
	13-24	6.5	8.1	7.9
	15-36	9.3	9.4	9.4
	37-48	-	10.9	10.8
Height (in cm)	0-12	60.6	61.1	60.3
	13-24	72.1	74.7	73.8
	15-36	80.0	80.4	80.2
	37-48	-	86.2	85.9
MUAC (cm)	0-12	12.2	12.5	12.7
	13-24	10.8	13.4	13.1
	15-36	13.6	13.3	13.6
	37-48	-	14.1	14.1
	n	11	95	482

* For weight, height and MUAC the average scores per age group are presented (boys and girls)
** Though 11 children were lost for follow-up due to death, nutritional status information at baseline is known for only 10 of them

Table 4.12 shows that nutritional status at baseline, indexed by average scores on weight, height and MUAC, of the children who died later on does not seem to differ considerably from that of their surviving counterparts as revealed by the follow-up survey. As noted in subsection 3.3.3, MUAC was shown to be a sensitive predictor of the risk of dying from malnutrition, more so than weight-for-age (Fauveau 1994, p. 444). Among the 10 children who later died and whose nutritional status at baseline is known, 2 had a MUAC below 10.0 cm, which indicates a critical situation, and another 5 children had a MUAC below 12.5 cm at baseline, which is the cut-off point indicating *severe* malnutrition. These findings underline what we observed before, i.e. that mortality of these children is to a large extent probably related to nutritional status. The proportion of *severely* underweight or *severely* stunted children is, however, much higher among the first group (the children who would later die) as compared to the latter group (the 'survivors'): respectively 40 against 29 per cent (Table 4.13). Given the small number of records no firm conclusions can be drawn from this observation.

Table 4.13 Proportions of underweight and stunted under-five children at baseline: those who were lost for follow-up due to death or migration versus those who were enrolled in the follow-up survey, Matlab 1988 (%)

Nutritional status		Among children lost for follow-up: death (%)	Among children lost for follow-up: migration (%)	Among children in follow-up study (%)
Underweight	moderate	30	41	41
	severe	40	31	29
Stunted	moderate	30	40	36
	severe	40	31	29
	n	11	95	482

4.5 Conclusions and discussion

The aim of this chapter was to introduce a brief profile of the study population in childhood and adolescence. Some basic demographic and socio-economic characteristics of *individual* children and of the *households* to which they belonged, in respectively 1988 and 2001 (n=562), were presented. This sketch pertained to the sample of children who survived and remained living in Matlab, as measured at the moment of baseline and follow-up survey. Data on children who were lost for follow-up due to death or migration were analysed separately (n=106). We looked at their demographic and socio-economic characteristics, based on data collected in the baseline survey, and cause of death as well as reason for migration, on the basis of data routinely collected by HDSS of ICDDR,B.

A few salient findings have emerged from the analyses presented in this chapter. Regarding educational level, we learned that adolescents are in general much higher educated than their parents were. Among the adolescents, school enrolment is high: 98 per cent ever went to school and 85 per cent was still school-going at the moment of interview at follow-up. Hardly any bias was found by sex. In contrast, at baseline, the proportion of fathers and mothers who did not complete a single year of education amounted to 53 and 75 per cent respectively. In general, the adolescents enrolled in our study display a great eagerness to pursue their educational career.

Although in general the population is still poor, in terms of socio-economic status the situation seems to have improved slightly between the moment of baseline and follow-up survey if we consider for instance the proportions of households living in a house with a tin wall (26 per cent in 1988 against 47 per cent in 2001) and with a tin roof (93 per cent in 1988 against 99 per cent in 2001).

The number of children who passed away before the onset of the follow-up study was small (n=11). It should be remembered that the majority (64 per cent) of the total baseline population (i.e. the 707 children) was already older than one year at the onset of the baseline survey, and hence, had passed the critical first 12 months of life. Among the causes of death, one was directly nutritional related (malnutrition associated with diarrhoea), whereas most of the other causes might be related to nutritional status indirectly (such as shigellae, pneumonia). Another 90 under-fives were lost for follow-up because of migration. Among these children who migrated out of the Matlab area, 76 did so with their family. At baseline, no differences were observed in terms of demographics or socio-economic status between the 'survivors and stayers' and the children who later died or migrated. At baseline, the proportion of children *severely* underweight and the proportion of children *severely* stunted appeared to be higher among the children who passed away before the onset of the follow-up study - but the number of cases is small - as compared to the numerical value of those enrolled in the follow-up study.

It is against this general background that in the succeeding chapters the link between nutritional status in early life and adolescence will be analysed (Chapter 5) followed by a study on menarche and spermarche, in relation to anthropometric determinants (Chapter 6), and the adolescents' reproductive knowledge and perceptions (Chapter 7).

5 Adolescent nutritional anthropometry in relation to nutritional anthropometry in early childhood

5.1 Introduction

This chapter focuses on two related topics: adolescent nutritional status, indicated by anthropometry, and its predisposition by nutritional status in early life, notably in early childhood and at birth. The analyses are conducted by taking a *lifecourse* perspective. We do this by linking two sets of data collected among the same individuals at two moments in time, i.e. early childhood (1988-1989) and adolescence (2001). Data on conditions at birth of the adolescents are collected in 2001 by means of retrospective recall by the adolescents' mothers. In addition, an intergenerational dimension is brought into the analyses because an impaired nutritional status of parents, particularly that of the mother, may be passed on to children (section 2.3). Such an 'inheritance' can either be biological in nature, relating to genetic dispositions at conception in conjunction with poor intrauterine environmental and nutritional conditions during the pregnancy, or it can be due to socio-cultural or socio-economic circumstances, for instance, poor living conditions that are shared by mother and child, through which the culture of poverty and malnutrition is perpetuated. We analyse the extent to which height of the adolescent's mother forms a predictor of level of stunting of her child, both in early childhood as well as adolescence. Maternal height is assessed in 2001, but since height can be regarded to be 'stable' from adulthood onwards we assume that it can be used as a proxy of maternal height at the moment the respondent was conceived.

Nutritional status development is *sex-specific* but may also be related to gender. The sex of the child is important from a biological point of view as there are considerable differences between boys and girls in size and timing of the adolescent growth spurt and associated growth changes (WHO 1995, p. 276). Growth (height) velocity for instance generally peaks later for boys as compared to girls, and hence, the adolescents' catch-up potential may differ by sex, i.e. a greater potential for girls than for boys (subsection 2.2.3). However, we should also keep in mind that due to socio-cultural factors there may be intra-household differences in feeding patterns and care-giving behaviour of parents towards sons and daughters (subsection 2.3.2), causing the intergenerational cycle of growth failure to be *gender-specific*, affecting girls in particular, and possibly counterbalancing girls' potential to catch up early childhood growth failure. Analyses presented in this chapter are carried out separately for boys and girls.

Working further from research questions 2 and 3 (see section 1.3), which are based on the review presented in sections 2.2 and 2.3 in particular, in this chapter we aim to study the following:

- the nutritional status of adolescent boys and girls as indicated by anthropometry (section 5.2);
- the predisposition of early childhood nutritional status (indicated by an average figure based on a number, 1 to 14, of measurements in early childhood, i.e. taken between the ages 0 to 5 years) for nutritional status in adolescence (section 5.3);
- the predisposition of conditions at birth (including young maternal age, i.e. an age of 19 years or younger of the adolescent's mother at the time of birth, (recalled) birth weight, size at birth and relative timing of the birth) for nutritional status in adolescence (section 5.4);

- the predisposition of height of the adolescents' mothers for nutritional status in early childhood and adolescence (section 5.5); and
- finally, we address the relative contribution of a selection of the aforementioned contemporary and early life nutritional predictors to the likelihood of being stunted in adolescence (section 5.6). We study this by means of binary logistic regression models.

Figure 5.1 outlines the aforementioned topics addressed in this chapter and Table 5.1 gives a description of the sample. Missing data (reasons for omission, potential influence on the results) are discussed in the respective (sub)sections. Conclusions of this chapter are discussed in section 5.7.

Figure 5.1: Outline of analyses

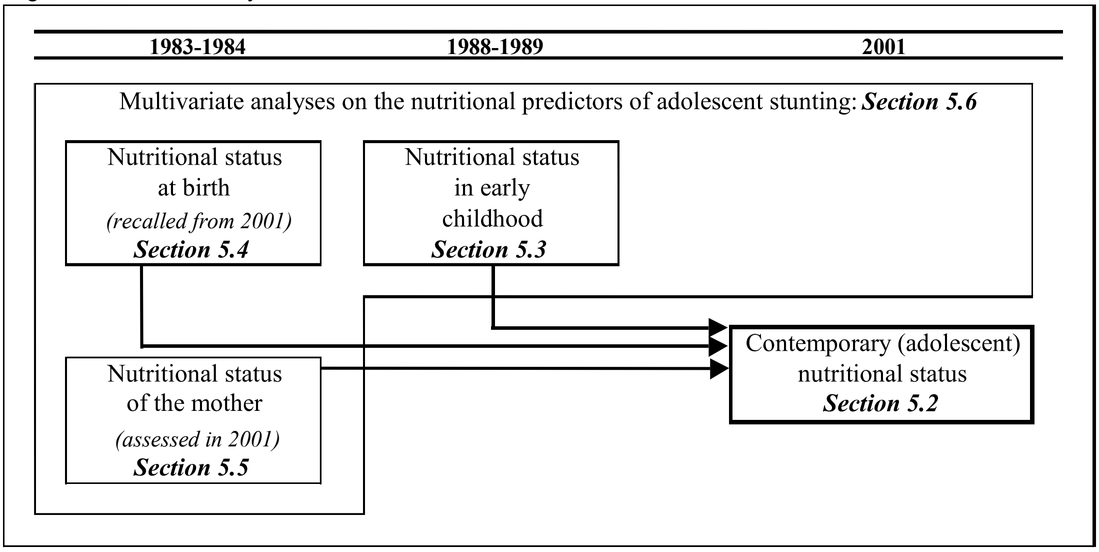


Table 5.1 Sample: main variables in analyses on nutritional status

Total number and percentage of children enrolled at baseline	707	%
Adolescents at follow-up	562	*79*
By sex		
boys	307	*55*
girls	255	*45*
Children at baseline	699	*99*
By sex		
boys	316	*45*
girls	383	*54*
Boys and girls by antropometry		
in adolescence	485	*69*
in early childhood	699	*99*
in adolesence and early childhood	482	*68*
Boys and girls by maternal height		
and anthropometry in adolescence	439	*62*
and anthropometry in early childhood	488	*69*
Boys and girls by recalled birth weight		
and anthropometry in adolescence	272	*38*
and anthropometry in early childhood	308	*44*
Boys and girls by recalled size at birth		
and anthropometry in adolescence	482	*68*
and anthropometry in early childhood	545	*77*

5.2 Adolescent nutritional status according to anthropometry

The aim of this section is to describe the nutritional status of the study population in adolescence by sex and age. We will do this by discussing for each sex scores for respectively weight, height (subsection 5.2.1), and relative to age, the adolescents' underweight (weight-for-age) and stunting (height-for-age) profiles (subsection 5.2.2). Finally, adolescent BMI is discussed (subsection 5.2.3). As elaborated in Chapter 3 (section 3.3), the application of BMI to adolescents is still in its infancy since there are "currently no accepted BMI reference curves available for children or adolescents" (CDC 1999, p. 30).

5.2.1 Weight and height in adolescence

The core anthropometric indices, weight and height, are usually studied in relation to sex and age. Given the overall poor nutritional status of the population in Bangladesh in general (Chapter 2), we expect our adolescent study population to be largely malnourished. In Table 5.2 the group means (and minimum and maximum values) of weight (in kg) and height (in cm) are presented for 12 to 16- year-old adolescent boys (n=260) and girls (n=225). Adolescent boys weighed on average 31.3 kg and were 142.6 cm tall. Adolescent girls weighed on average 33.1 kg and were 143.1 cm tall.

Table 5.2 Adolescent weight and height by sex: mean and range, Matlab 2001

Sex	Indicator	Mean	Min	Max
Boys (n=260)	Weight (kg)	31.3	17.8	53.7
	Height (cm)	142.6	121.1	166.3
Girls (n=225)	Weight (kg)	33.1	17.1	56.8
	Height (cm)	143.1	114.5	164.1
Total (n=485)	Weight (kg)	32.1	17.1	56.8
	Height (cm)	142.8	114.5	166.3

As already indicated by the large gap between minimum and maximum values, we need to look at these indices by age (Table 5.3). Table 5.3 shows that at every age adolescent girls are on average heavier than their male counterparts. In Figure 5.2 the mean weight in adolescence is presented graphically. The graph clearly shows that the gap in weight between the sexes declines as age increases. Also with respect to height (Figure 5.3) adolescent girls take the lead, but this does not last for long: soon after reaching the age of 14 years, adolescent boys have caught up on their relative backlog. At the age of 15, adolescent boys are on average 148.8 cm tall, whereas the mean height among adolescent girls is 146.6 cm. The turning point is also clearly visible in Figure 5.3.

Table 5.3 Group means of adolescent weight and height by sex and age at interview, Matlab 2001

Sex	Indicator	Age at interview (in years) 12	13	14	15	16
Boys	Weight (kg)	25.6	27.4	31.8	35.1	38.7
	Height (cm)	132.9	137.0	143.6	148.8	153.5
	n	36	68	67	66	23
Girls	Weight (kg)	27.6	29.1	33.4	36.9	39.1
	Height (cm)	136.5	138.5	144.3	146.6	149.2
	n	38	35	84	38	30
Total	Weight (kg)	26.6	28.0	32.7	35.8	39.0
	Height (cm)	134.7	137.5	144.0	148.0	151.1
	n	74	103	151	104	53

Figure 5.2: Mean weight in adolescence by sex and age at interview, Matlab 2001

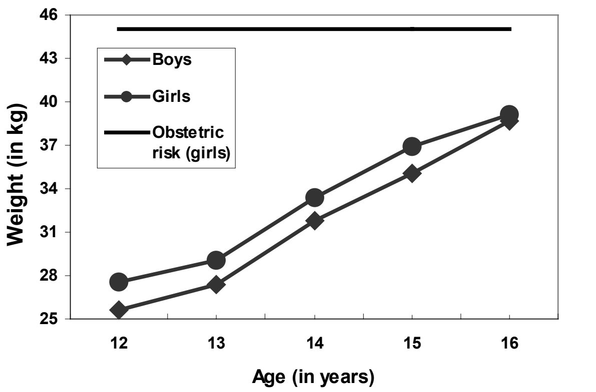
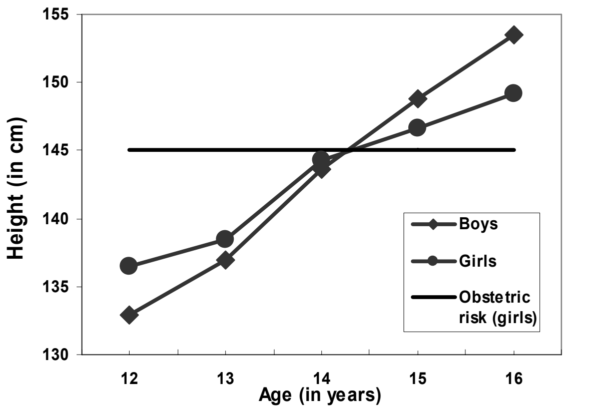


Figure 5.3: Mean height in adolescence by sex and age at interview, Matlab 2001



Potential implications for reproductive health

As elaborated in Chapter 2 (subsection 2.5.2), weight and height are anthropometric indices that become increasingly important for an adolescent girl in the event of pregnancy. Height in particular is important because of its association with pelvic size. In Figures 5.2 and 5.3 (page 123) the cut-off values for weight (45 kg) and height (145 cm) are drawn: below these two values a girl or woman may be at obstetric risk (WHO 2003, p. 22). The adolescent girls in our database have, given their age (12 to 16 years), not yet completed their growth curve. Let alone that they are pregnant (one girl appeared to be pregnant and was excluded from the analyses of nutritional status because her pre-pregnancy weight was not known). However, given the pressure for early marriage in Bangladesh in general (subsection 2.5.1) we take a closer look at the adolescent girls' weights and heights. Our data (not shown) reveal that almost all adolescent girls, 95 per cent, weigh at the time of the survey less than 45 kg, whereas over half of the adolescent girls, 55 per cent, is shorter than 145 cm. Obviously, many of these girls are still very young and not likely to get married and become pregnant soon. Nevertheless, if we select girls of 16 years only, we find that 83 per cent weighs less than 45 kg and 23 per cent is shorter than 145 cm. All girls who are shorter than 145 cm also weigh less than 45 kg. If this group of 16-year-old girls with a weight and/or height below the cut-off points would marry and have a child in the very near future, they would be at obstetric risk.

Cross-country comparisons

We compared the weight and height group means of our study population with those of similar-aged adolescent boys and girls in India. The Indian data are derived from a publication by the National Nutrition Monitoring Bureau (NNMB) of the National Institute of Nutrition of the Indian Council of Medical Research, in Hyderabad (NNMB 2002, p. 85). The data originate from surveys carried out in various rural Indian states in 2000 and 2001, and cover 51,300 individuals of different ages. The nutritional status of this Indian population was assessed by comparing sex- and age-specific weight and height values with those of the US National Centre for Health Statistics (US NCHS) reference population of 1971-1974 (NNMB 2002). As an example we consider the age that corresponds with the turning point in height in our sample, i.e. the earlier described age between 14 and 15 years when adolescent boys have caught up with their female counterparts. We then find that our study population has a slightly lower mean height and weight as their Indian peers: 15-year-old adolescent boys from Bangladesh are 149 cm tall and weigh 35 kg, whereas similarly aged boys from India are 152 cm tall and weigh on average 37 kg. However, both our Bangladeshi as well as the Indian population are considerably smaller and lighter than their counterparts in the US: the US NCHS figures for height and weight for 15-year-old American boys are respectively 168 cm and 55 kg. These absolute differences in weight and height scores are likely to be established early in life and should therefore be viewed against differences in weight and height in childhood as well. This we will do later in section 5.3.

5.2.2 Adolescent underweight and stunting

Sex and age-specific weight and height scores are usually analysed by making a comparison with the Z-scores prevailing in a healthy well-nourished reference population. We applied the CDC 2000 reference population (see section 3.3, for a further description of the reference populations) and generated underweight (weight-for-age) and stunting (height-for-age) profiles for the adolescents in our sample. Table 5.4 shows the level of adolescent underweight and stunting by sex (n=485).

Table 5.4 Distribution of adolescents by level of contemporary underweight (weight-for-age), stunting (height-for-age) and sex, Matlab 2001* (%)

	Z-scores	Boys (%)	Girls (%)	Total (%)
Underweight	Above -2 SD from median (*not underweight*)	8	23	15
	Between -3 and -2 SD from median (*moderate*)	26	31	28
	Below -3 SD from median (*severe*)	66	46	57
Stunting	Above -2 SD from median (*not stunted)*	21	32	26
	Between -3 and -2 SD from median (*moderate*)	43	40	41
	Below -3 SD from median (*severe*)	36	28	33
	n	100 (n=260)	100 (n=225)	100 (n=485)

** Using the CDC reference population of 2000 (US NCHS)*

Cross-country comparison of nutritional status: choice of reference population

A subject of discussion in research on nutritional status is the selection of an adequate reference population. For reason of international comparison generally the US NCHS reference population is used. These reference populations are constructed on the basis of carefully calculated averages of boys and girls of a certain age. However, the notion of comparing the anthropometry of a Bangladeshi study population with that of their American peers may be regarded as 'inappropriate', as Bangladeshi children will never be able to match their American peers. This is also reflected by our results: the level of nutritional status of the Bangladeshi study population is nowhere near that of their American counterparts. This raises the question whether we should continue to apply the US NCHS reference populations for assessing nutritional status in Bangladesh or developing countries in general. Should another reference population, one that is pertaining for instance to an Asian region and therefore presumably reflecting anthropometric characteristics that are more similar to the Bangladeshi study population, not be more appropriate? As demonstrated in this chapter, application of for instance an Indian reference population results in lower proportions of individuals within our study group with an impaired nutritional status.

While considering the application of region-specific reference populations we kept in mind the initial goal of the study, i.e. assessment of the nutritional status of the Bangladeshi study population. What would we gain if the analysis yielded 'better' results - i.e. a larger proportion of children with an adequate nutritional status - only because of using a different population for which the reference values are set lower? The 'advantage' gained this way would be disputable if we consider that for generations the Indian population may be suffering from malnutrition itself as well. Even an Indian reference population comprising children who have not suffered from serious diseases and growth failure at all, may still disqualify itself as a reference population - which, after all, should lay down the anthropometric sex and age-specific reference values - because these Indian children may carry the accumulated burden of malnutrition of previous generations. It may therefore not only be difficult to select children for an Indian reference population, but similar median anthropometric values across Indian and Bangladeshi children and adolescents may also disguise an impaired nutritional status rather than point to an adequately nourished population. Nevertheless, making cross-cultural comparisons of sex- and age-specific anthropometric values should not be completely rejected. Nutritional status is per definition assessed relatively, i.e. viewed in relation to nutritional status in other populations, and application of multiple reference populations could be considered.

These adolescent underweight and stunting profiles are also illustrated in Figure 5.4 and Figure 5.5 respectively.

Figure 5.4: Distribution of adolescents by level of contemporary underweight and sex, Matlab 2001 *(CDC 2000 reference population)* (%)

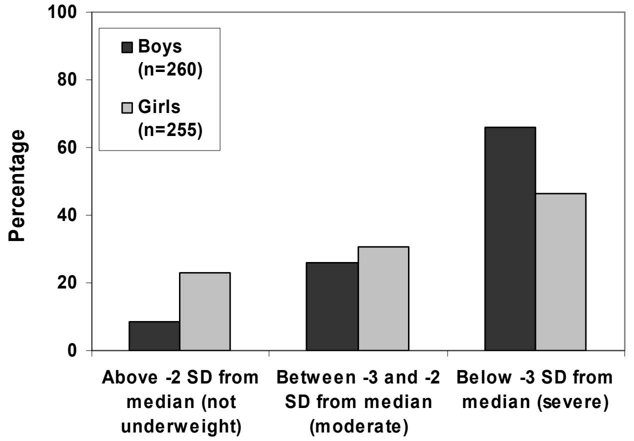
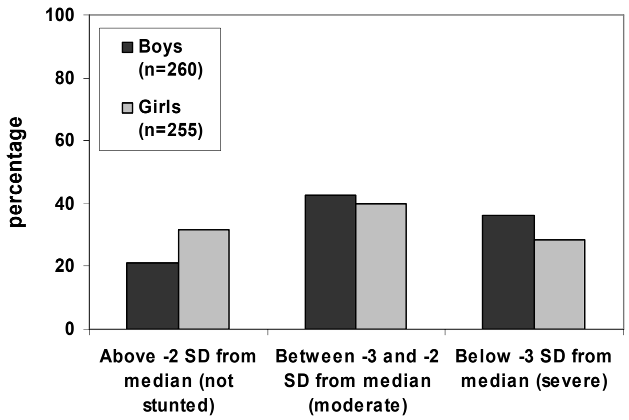


Figure 5.5: Distribution of adolescents by level of contemporary stunting and sex, Matlab 2001 *(CDC 2000 reference population)* (%)



The data reveal that respectively 26 and 66 per cent of the adolescent boys and 31 and 46 per cent of the adolescent girls are *moderately* (between -3 and -2 SD) and *severely* (<-3 SD) underweight. In addition, 43 and 36 per cent of the adolescent boys and 40 and 28 per cent of the adolescent girls are *moderately* (between -3 and -2 SD) and *severely* (<-3 SD) stunted. The cut-off level of -2 Z-scores is generally considered appropriate in the selection of malnourished individuals. However, as noted by Hellen Keller International (1993, p. 5), "in Bangladesh stunting and underweight are so common that '-3 Z-scores' is relevant to describe the most severely stunted or underweight". Our data confirm, as is also clearly evident in particularly Figure 5.4, the observation of Hellen Keller that it is indeed useful to consider the -3 Z-scores cut-off point as well. Although the proportions of *moderate* and *severe* underweight among adolescent boys and girls are relatively high, the proportion of underweight adolescent boys is *exceptionally* high and requires further analysis. We will come back to this later when we discuss the adolescents' weight-for-age or underweight profiles for one-year age groups separately.

Underweight by sex and age

Table 5.5 presents the weight-for-age data broken down by sex and age at interview (in years). It appears that at every age the vast majority (ranging from 61 to 70 per cent) of the adolescent boys is *severely* (<-3 SD) underweight. For adolescent girls, however, only the age of 13 seems to be critical, in the sense that 60 per cent of girls at this age is *severely* (<-3 SD) underweight. When the underweight profiles for each sex are compared, it becomes clear that far more adolescent girls (17 to 27 per cent) are *not underweight* (>-2 SD). The proportion of girls that is *not underweight* increases with age. Among adolescent boys, 4 to 12 per cent are *not underweight* (>-2 SD).

Table 5.5 Distribution of adolescents by level of contemporary underweight (weight-for-age), sex and age at interview, Matlab 2001* (%)

	Age (in years)	> -2 SD not underweight	-3 to -2 SD moderate	< -3 SD severe	Total
Boys	12	8	25	67	100 (n=36)
	13	6	24	70	100 (n=68)
	14	9	30	61	100 (n=67)
	15	12	23	65	100 (n=66)
	16	4	30	66	100 (n=23)
Girls	12	18	42	40	100 (n=38)
	13	17	23	60	100 (n=35)
	14	25	29	46	100 (n=84)
	15	26	32	42	100 (n=38)
	16	27	30	43	100 (n=30)

** Using the CDC reference population of 2000 (US NCHS)*

The difference in level of underweight between adolescent boys and girls, and particularly the exceptionally high proportions of underweight among boys at every age in early adolescence needs to be studied further. The nutritional situation is considered to be serious if the proportion of underweight within a specific population is more than 40 per cent (Leemhuis-de Regt 1998, p. 111). The relatively high proportion of underweight adolescent boys in our sample may need to be seen in view of the choice of the reference population, which consists of healthy well-fed American children. However, in the aforementioned Indian population (NNBM 2002, p. 92), which is more comparable to the Bangladeshi population in our sample, no significant differences were found between the sexes in prevalence of weight-for-age in the 6 to 9 and the 10 to 13-year-age groups. Interestingly though, in the 14 to 17-year-age group boys were indeed more often undernourished than girls (respectively 73 against 60 per cent). It should be noted that the Indian data do not reflect separately the proportion of *severely* underweight, but rather the categories *moderate* (between -3 and -2 SD) and *severe* (<-3 SD) are pooled together. Although adolescent boys in this Indian population are thus more likely to be underweight as compared to adolescent girls at the ages between 14 and 17, this similarity does not as yet provide us with an explanation for the exceptionally high proportion of *severely* (<-3 SD) underweight adolescent boys in our sample.

What may bring us closer to an explanation of the difference in level of severely underweight by sex is the difference in onset of adolescent growth spurt. As noted by Heald 1985, p. 53) "in early adolescence girls tend to be heavier and taller than boys, because girls undergo puberty two years earlier than boys", and - herewith related - the spurt occurs two years later in boys than in girls, but is greater and lasts longer in boys (Lachance 1995, p. 7). In girls, under the influence of hormones that generate sexual maturity processes (onset of menstrual cycle, breast development) the deposition of body fat may become more pronounced, and hence, have an increasing effect on their weight-for-age scores. It could be hypothesised that in boys, the first signs of a possible growth spurt may foremost be reflected by gains in height rather than weight. Obviously, the difference in peak of growth velocity and the hypothesised related influence on differences in weight-for-age scores between boys and girls should also be present in the American reference population as well, and hence, does therefore not provide us with an explanation for the exceptionally high proportion of *severely* (<-3 SD) underweight Bangladeshi adolescent boys. However, in contrast to the Bangladeshi (and Indian population for that matter), the American reference population is not likely be malnourished from birth or early childhood onwards. As a consequence, American boys do not need to catch up early life growth faltering, which could be the case among the Bangladeshi adolescent population. It could be hypothesised that boys in early adolescence *in general* have a tendency to be 'just lean' (or in the words of one of the interviewers: '*the respondent looks small*') and they catch up their weight (relative to their height) at a later stage in adolescence, but that in *grossly malnourished* populations, such as our sample of Bangladeshi boys, the later peak in adolescent growth spurt postpones catch-up growth in malnourished boys, whereas the earlier peak in adolescent growth enhances catch-up growth in malnourished girls.

Stunting by sex and age
Table 5.6 presents the level of contemporary stunting by sex and age at interview (in years). It shows that between 33 (minimum at age 15) to 48 (maximum at age 16) per cent of the adolescent boys is *moderately* (between -3 and -2 SD) stunted.

Table 5.6 Distribution of adolescents by level of contemporary stunting (height-for-age), sex and age at interview, Matlab 2001* (%)

	Age (in years)	> -2 SD not stunted	-3 to -2 SD moderate	< -3 SD severe	Total
Boys	12	22	47	31	100 (n=36)
	13	20	43	37	100 (n=68)
	14	19	48	33	100 (n=67)
	15	24	33	43	100 (n=66)
	16	17	48	35	100 (n=23)
Girls	12	34	42	24	100 (n=38)
	13	17	43	40	100 (n=35)
	14	29	40	31	100 (n=84)
	15	34	42	24	100 (n=38)
	16	50	30	20	100 (n=30)

** Using the CDC reference population of 2000 (US NCHS)*

In our sample, 15-year-old boys are most likely (43 per cent) to be *severely* (<-3 SD) stunted. The stunting profile of adolescent girls points to a relatively more adequate nutritional status as compared to that of their male peers. Considerable proportions of adolescent girls, and even 50 per cent of the 16-year-old girls in our sample, are *not stunted* (>-2 SD). As was the case with underweight, the highest proportion of *severely* (<-3 SD) stunted is found among 13-year-old girls (40 per cent).

5.2.3 Adolescent Body Mass Index

As indicated in section 3.3, Body Mass Index (BMI) considers weight relative to height and is calculated by weight (in kg) divided by square height (in metres). A low BMI reflects *chronic energy deficiency* (CED). There are currently no accepted BMI reference curves available for children or adolescents (CDC 1999, p. 30). Scores on adolescent BMI would fall below the scales generally used (see subsection 3.3.2 for the reference values used). If we calculate for instance the mean, minimum and maximum BMI for the population in our sample (both sexes and all ages combined) we obtain the following results: 15.6, 11.5 and 21.6. Considering that a BMI below 18.5 indicates CED, these values would point to an extremely malnourished population. Although CED according to BMI may not be an appropriate indicator for adolescent nutritional status as such, it is plausible to assume that *across* adolescent populations worldwide, developments in weight and height take place in a comparable manner. We therefore expressed the Bangladeshi adolescents' CED according to BMI Z-scores, whereby the reference population constitutes a well-nourished population of the same sex and chronological age (US NCHS CDC 2000 reference population). Figure 5.6 presents the distribution of adolescents in our sample by level of CED according to BMI Z-scores and sex.

Figure 5.6: Distribution of adolescents by level of CED according to BMI Z-scores and sex, Matlab 2001 ***(CDC 2000 reference population)*** **(%)**

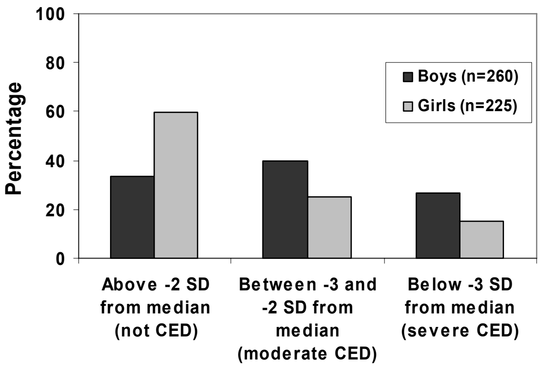


Figure 5.6 shows the wide prevalence of malnutrition among adolescents in Bangladesh, though not on a large scale or severe level. In fact, nutritional status as measured by CED according to BMI Z-scores seems to reflect a 'better', in the sense of lower proportions of malnutrition, picture of the adolescents' nutritional status as compared to the underweight and stunting indicators. About a quarter, 27 per cent, of the adolescent boys and 15 per cent of the adolescent girls are *severely* (<-3 SD) malnourished, i.e. show signs of a CED according to BMI Z-scores. Adolescent boys are relatively more often affected than adolescent girls: of the adolescent boys, 40 per

cent is *moderately* (between -3 to -2 SD) malnourished, against 25 per cent of their female counterparts. Adolescent boys and girls with no signs of CED according to BMI Z-scores (>-2 SD) account for respectively 33 and 60 per cent. In line with the earlier described underweight and stunting profiles, the nutritional status of adolescent girls as opposed to adolescent boys as indicated by CED according to BMI Z-scores is more adequate.

BMI by sex and age

Since BMI is an adult indicator of nutritional status, it seems plausible to assume that when we apply this measurement to adolescents the result becomes more 'appropriate' (valid) when their age increases. The age-specific scores on BMI Z-scores may tell us something about sex-specific patterns of growth spurts with regard to their weight relative to their height. In Figure 5.7 and Figure 5.8, the distribution of respectively adolescent boys and girls by level of CED according to BMI Z-scores are presented by age at interview (12 to 16 years). The proportion *severely CED according to BMI Z-scores* (<-3 SD) among boys slightly increases by age, i.e. from 22 per cent at the age of 12 to 30 per cent at the age of 16 years. The majority of the adolescent girls who are *not CED according to BMI Z-scores* (>-2 SD) are found at the ages of 14, 15 and 16 years. We cannot rule out the possibility that this is an age effect, i.e. that the older girls are less often malnourished than their younger counterparts. Such a clear pattern by age was however not observed while analysing adolescents' nutritional status on the basis of underweight and stunting. It is therefore likely that this finding is related to the type of measurement used. Patterns of weight and height velocity may differ in early adolescence and the higher the age the more likely it is that weight and height are 'in balance' with each other, and hence, that BMI can be considered an appropriate measurement. Because of the square of height in the equation, BMI is particularly sensitive to increases in height.

Figure 5.7: Distribution of adolescent boys by level of CED according to BMI Z-scores and age at inteview, Matlab 2001 (*CDC 2000 reference population*) (%)

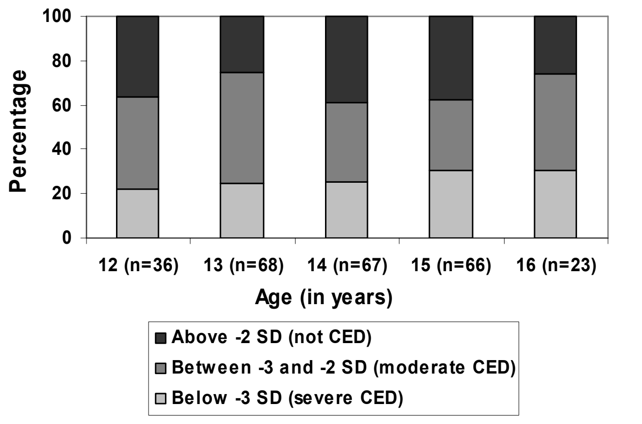
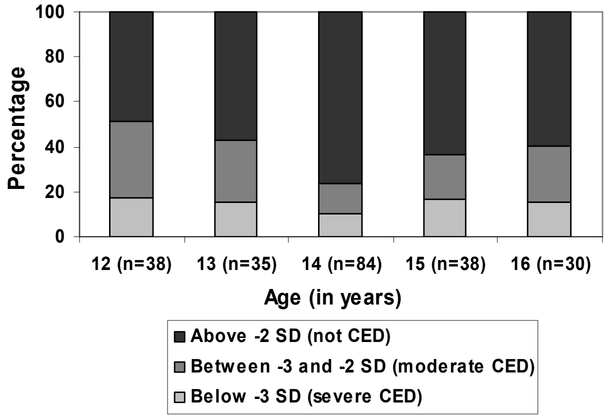


Figure 5.8: Distribution of adolescent girls by level of CED according to BMI Z-scores and age at interview, Matlab 2001 (*CDC 2000 reference population*) (%)



As discussed earlier, among our study population adolescent girls are heavier than boys throughout the ages 12 to 16 years. However, the growth spurt in height affects BMI the most and adolescent boys are still relatively short at these ages. We already observed that boys in our sample catch up their relative backlog in height at the age of 15 years. CED according to BMI Z-scores at higher ages will probably show therefore a more ‘positive’ picture of the boys’ nutritional status, i.e. as indicated by smaller proportions of *severely CED according to BMI Z-scores* (<-3 SD), as compared to nutritional status at lower ages.

In sum, the nutritional status of both adolescent boys and girls in our sample is far from adequate, and less than that of their Indian peers. Adolescent girls in our sample are less often malnourished than their male counterparts: for instance, respectively 66 and 46 per cent of the boys and girls are *severely* (<-3 SD) underweight, whereas respectively 36 and 28 per cent are *severely* (<-3 SD) stunted. The large differences in age- and sex-specific weight and height scores with the (American) reference population is likely to be rooted earlier in life and should therefore be viewed in relation to nutritional status in childhood as well. This will be examined in section 5.3.

Note on seasonality

The follow-up survey among adolescents was carried out between February and May, and could have been affected by the seasons. It is pertinent to note that the survey took place partly in the dry winter season (from October to February) and in the hot dry period (from March to June). The survey was scheduled far in advance of the monsoons and corresponding floods, that are in turn associated with an instant increase of infectious and diarrhoeal diseases, and hence likely to affect nutritional status, particularly weight. The end of the period of data collection coincided with one of the two harvests that take place each year: the Boro harvest in April-May. The Aman harvest takes place annually in November-December. Given that our data were collected in a period during which the weather was in general agreeable and which could be characterised by relative food abundance, with one harvest just finished and the other taking place, we have no reasons to believe that the individuals under survey were adversely affected by unfavourable seasonal conditions.

5.3 Long-term consequences of nutritional status in early childhood

The aims of this section are twofold. Firstly, we explore the nutritional status of the study population in early childhood, i.e. between the ages 0 to 5 years. We examine the under-fives' weight, height and mid-upper arm circumference (MUAC) (subsection 5.3.1) followed by their underweight and stunting profiles (5.3.2). Secondly, we study to what extent early childhood nutritional status may have formed a predisposition for nutritional status in adolescence (subsection 5.3.3). We also explore whether some ages in early childhood are more 'sensitive' than others, meaning that an inadequate nutritional status at these ages may have a greater impact on adolescent nutritional status than at other ages within the period of early childhood. As described in sections 3.3 and 3.6 the data for this part of the analyses are derived from a study on the epidemiology of persistent diarrhoea in Bangladeshi children by Baqui (1990). The under-five children enrolled in Baqui's study have been measured a variable number of times, with a maximum of 14, within an approximate two-year period. At the moment of the first measurement, the youngest child enrolled was less than 1 month old, whereas at the last measurement the eldest child was 59 months or almost 5 years old.

5.3.1 Weight, height and MUAC in childhood

In Table 5.7 the mean scores for weight, height and mid-upper arm circumference (MUAC) in early childhood are presented by sex and age (in months) at the moment of the first measurement, in 1988. As indicated in subsection 3.3.2, a *low* MUAC reflects acute malnutrition. Apart from adults, MUAC is used for children between the ages of 6 months to 5 years (Leemhuis-de Regt 1998, p. 111). In Table 5.7 the group means of MUAC are presented for all under-five boys and girls falling within these age ranges. The cut-off point below which under-fives are considered to be malnourished is 13.5 cm. An MUAC below 12.5 cm points to *severe* malnutrition and an MUAC below 11 cm indicates that the situation is acute.

Table 5.7 Group means of anthropometric indices in childhood by sex and age at the first measurement, Matlab 1988

		Age (in months)			
Sex	**Indicator**	**0-12***	**13-24**	**25-36**	**37-48**
Boys	Weight (kg)	5.5	8.2	9.6	11.3
	Height (cm)	61.0	74.6	81.0	87.5
	MUAC (cm)	12.8	13.3	13.7	14.3
	n	122	91	91	43
Girls	Weight (kg)	5.0	7.6	9.0	10.3
	Height (cm)	59.3	73.0	79.1	84.5
	MUAC (cm)	12.5	12.8	13.4	13.8
	n	89	96	58	47
Total	Weight (kg)	5.3	7.9	9.4	10.8
	Height (cm)	60.3	73.8	80.2	85.9
	MUAC (cm)	12.7	13.1	13.6	14.1
	n	211	187	149	90

** Within this age group MUAC is calculated for children aged 6-12 months only (n=71; 43 boys and 28 girls)*

Table 5.7 shows that as expected the increase in weight and height was high in infancy, tapering off in the second through third year of life. For example, for the sexes combined, the difference in average height between the age groups 0 to 12 and 13 to 24 months amounts to 13.5 cm, and between the following age groups respectively 6.4 and 5.7 cm. It is also apparent that for every age category in early childhood, boys are on average heavier and taller than their similarly aged female counterparts. In the age group 13 to 24 months, for instance, boys weigh on average 8.2 and girls 7.6 kg. The average height for boys and girls in this age group is respectively 74.6 and 73.0 cm.

MUAC is an indicator for fat reserves. According to the average scores on MUAC, the under-five population is indeed malnourished, though not on a severe level. Boys are malnourished on average at the ages 6 to 12 and 13 to 24 months. Girls are on average also malnourished at these ages but as well as at the ages of 25 to 36 months. This observation is in general accordance with findings reported for other rural areas in Bangladesh: in Chakaria, 44 per cent of the under-five children had a MUAC below 13 cm, of whom 47 per cent were below 12 cm (Bhuiya 1996, p. 31). We also checked our database for scores for MUAC below 11 cm, the ‘emergency cut-off point’. We found that the percentages of under-fives (boys and girls) who are in acute need fluctuate across the respective measurements and that the highest proportion of children with a MUAC below 11 amounts to 2 per cent. Girls make up the larger group of these *severely* malnourished under-fives.

Height increase

Apart from the period of gestation, growth velocity is never higher than in infancy (subsection 2.2.3). Assuming that the children enrolled were about 50 cm long at birth - which is probably relatively high considering that this is the length of an average child at birth *in general* (Cameron and Hofvander 1983, p. 4) - we observe in Table 5.7 that our data corroborate this notion on growth velocity being highest in infancy. The difference in average height between the age groups 0 to 12 and 13 to 24 months (both sexes combined) amounts to 13.5 cm. At higher ages, differences in average height between the respective age groups (13 to 24, 25 to 36 and 37 to 48 months) decreases to 6.4, 6.5 and 5.7 cm respectively. We should stress though that the averages calculated for the respective age groups, as presented in Table 5.7, pertain to different groups of individuals. Strictly speaking, we cannot say anything about growth velocity on the basis of these data because they do not reflect anthropometric measurements of the same individuals *over time*. A *within-subject* design, whereby data on nutritional status at childhood and in adolescents are linked at an individual level, is presented in section 5.3.3.

In the baseline survey, the age gaps ($\Delta age = age_n - age_{n-1}$) between one measurement and the next do not only vary *within* one record (i.e. vary within a series of individual measurements) but are also different *across* the records (i.e. vary across the group of individuals). In addition, some children have been measured two times within one month (for instance at the beginning and at the end of a month) whereas other measurements have been skipped. The two following cases may illustrate the irregularity in the (timing of the) taking of anthropometric measurements. For instance, 13 anthropometric measurements were taken for an under-five child at the age of respectively 6, 7, and 8 months, then again a few weeks later at month 8, then at months 9, 11, 12, again at month 12, then at month 14, followed by another measurement later at month 14, then at month 15, 16 and finally at month 17. For another child anthropometry was measured at the ages of respectively 19, 21, 23, and 25 months, then again later in month 25, then at months 26, 27, 28, 29, 30, and finally at month 31, whereby it should be noted that within this particular latter series of measurements, the second one was missed. As a consequence of this irregularity of timing of measurements it is virtually impossible to say anything about growth velocity on the basis of comparing a set of series of measurements *within* one record (pertaining to one individual under-five child) and *across* the records (thus pertaining to the whole group of under-five children).

In order to circumvent the aforementioned problem we sub-selected those under-five children from our sample for whom each measurement took place *one month* after the last one. Thereafter we ordered these cases by age (in months) at enrolment. For these children (n=171) we looked at the *average* height measurements by sex and age at onset (provided the number of cases per sex and age at enrolment were larger than 1, otherwise the observed height is presented). Table 5.8 illustrates height development on the basis of 33 cases.

Table 5.8 Average height: selected cases with different age at onset, but equal increases in age of one month per measurement, Matlab 1988-1989

Age at onset		Height measurements taken within one-month intervals (in cm)													
(in months)	Sex	1st	2nd	3th	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	n
2	M	55.6	59.1	61.6	62.4	63.9	64.8	64.9	66.6	67.9	69.3	69.9	70.7	71.7	2
2	F	55.0	57.4	59.0	60.5	60.5	61.7	62.6	63.7	64.2	65.1	65.9	66.0	66.5	1
6	M	66.6	67.7	68.6	69.3	69.7	71.4	72.6	73.1	73.3	75.1	76.0	77.0	77.6	2
5	F	61.8	65.7	66.2	66.8	67.4	68.8	69.2	70.3	70.0	70.7	71.3	71.7	72.5	2
12	M	68.3	69.0	69.8	70.2	71.0	71.2	71.2	73.1	73.2	72.8	74.0	74.1	78.2	4
12	F	69.0	70.7	71.5	71.9	72.2	73.1	73.6	74.2	75.4	75.6	76.8	77.0	77.3	2
23	M	76.4	77.1	77.5	77.6	78.5	83.2	79.2	80.3	80.6	80.8	80.3	81.6	83.6	4
23	F	74.4	75.6	76.1	73.5	74.0	82.0	74.1	75.0	75.0	75.5	75.5	75.8	80.1	2
30	M	79.1	80.0	76.8	80.2	80.9	81.2	81.3	81.4	82.5	82.3	82.8	83.1	83.7	2
30	F	78.8	79.9	80.4	80.9	81.4	81.7	82.3	82.5	82.9	83.0	83.2	83.7	84.6	4
36	M	83.6	84.5	85.0	86.5	86.7	86.8	87.1	87.1	85.3	85.5	88.6	89.2	89.7	2
36	F	80.3	79.2	82.4	82.5	85.7	83.3	84.1	84.5	85.6	85.9	84.0	87.3	87.5	2
46	M	90.1	91.5	92.1	92.5	92.6	92.8	93.3	93.7	94.0	94.4	94.9	95.7	96.4	2
46	F	86.3	-	87.7	89.4	89.8	93.0	90.4	87.8	91.4	88.1	91.9	93.2	90.5	2

Given the small number of cases for each sex and age (between 1 and 4 years) we cannot make generalisations on the basis of the data presented in Table 5.8. The data do however illustrate that the largest increases in height (length) take place indeed in the first two years of life and that linear growth velocity slows down by increasing age for these particular cases. However, among the cases presented the total observed increase in length in the first year is smaller than what is observed in normal populations, which is about 25 cm (Cameron and Hofvander 1983, p. 4). For instance, the two-month-old boys who were on average 55.6 cm tall at the time of their first measurement gained only 16.1 cm in height during their first year in life and hence, measured on average 71.7 cm 12 months later. Their similar-aged female counterpart, who was almost equally tall at the time of first measurement, gained only 11.5 cm and, hence measured 66.5 cm 12 months later. That boys in our sample are generally taller than similar-aged girls is a finding which we already observed (see Table 5.7).

5.3.2 Childhood underweight and stunting

Weight and height should be considered relative to age. In Table 5.9 and Figures 5.9 and 5.10 the level of childhood underweight (weight-for-age) and stunting (height-for-age) is shown for the study population by sex.

Table 5.9 Distribution of study population by level of childhood underweight (weight-for-age), stunting (height-for-age) and sex, Matlab 1988* (%)

	Z-scores	Boys (%)	Girls (%)	Total (%)
Underweight	Above -2 SD from median (*not underweight)*	30	31	30
	Between -3 and -2 SD from median (*moderate*)	47	33	41
	Below -3 SD from median (*severe*)	23	36	29
Stunting	Above -2 SD from median (*not stunted*)	36	33	34
	Between -3 and -2 SD from median (*moderate*)	42	40	36
	Below -3 SD from median (*severe*)	22	37	29
	n	100 (n=258)	100 (n=224)	100 (n=482)

* *Using the CDC/WHO reference population of 1978 (US NCHS)*

Figure 5.9: Distribution of study population by level of childhood underweight and sex, Matlab 1988 *(CDC/ WHO 1978 reference population)* (%)

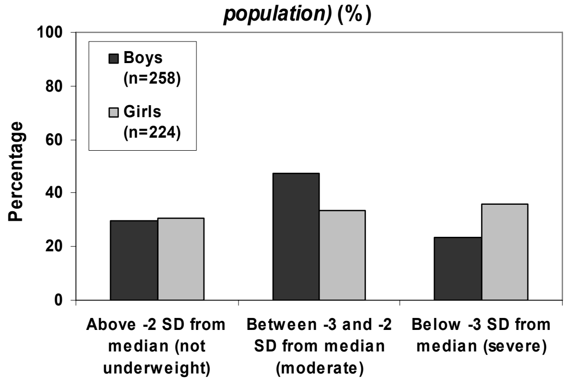
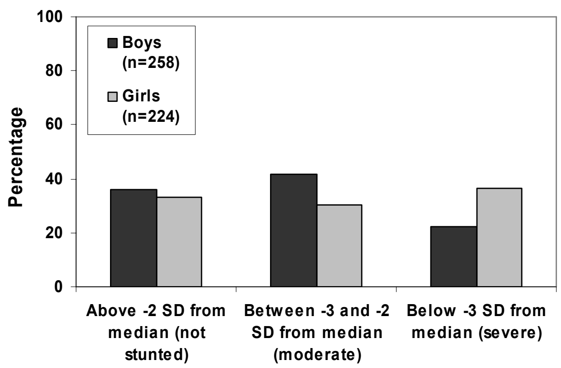


Figure 5.10: Distribution of study population by level of childhood stunting and sex, Matlab 1988 *(CDC/ WHO 1978 reference population)* (%)



Among under-five boys, 47 per cent was *moderately* (between -3 and -2 SD) and 23 per cent *severely* (<-3 SD) underweight in early childhood. The corresponding figures for under-five girls are respectively 33 and 36 per cent. Stunting was also highly prevalent among our study population in childhood. Among the under-five boys, 42 per cent was *moderately* (between -3 and -2 SD) and 22 per cent was *severely* (<-3 SD) stunted. Among under-five girls, 40 and 37 per cent was respectively *moderately* and *severely* stunted. Also from Figures 5.9 and 5.10 we learn that girls are indeed relatively more often *severely* (<-3 SD) underweight and stunted. However, if we consider two categories together (*moderate* and *severe* underweight respectively stunting) this difference is almost counterbalanced. The two categories taken together reveal the following for boys and girls respectively: 70 against 69 per cent (underweight) and 64 against 67 per cent (stunted). Both the underweight as well as the stunting profiles of the under-five children may have been affected, in an unfavourable way, by floods in 1987 and 1988, which caused widespread damage to the country (Hellen Keller International 1992, p. 2).

Calculation of level of childhood underweight and stunting

The under-five population has been measured a variable number of times, with a maximum of 14, within an approximate two-year period. For every anthropometric measurement that was taken, we compared sex- and age- (in months) specific weight and height scores with those of a well-nourished reference population of the same sex and age (CDC/WHO reference population of 1978). Obviously, the number of underweight (weight-for-age) and stunting (height-for-age) profiles that we generated for every individual this way varied from 1 to 14 as well. Given our questions of research, whereby our main aim is to study the linkage between nutritional status in early childhood and adolescence, we needed to have one overall underweight profile and one overall stunting profile for every under-five child for the entire approximate two-year period (1988-1989). We therefore calculated an average score for underweight and stunting based on the maximum number of underweight and stunting profiles available for each child. We consider these two generated averages as 'summary' indicators for nutritional status in childhood. Given that these two summaries are based on sex- and age-specific weight and height scores that are compared with those of a healthy reference population over an approximate two-year period, the possible effect of seasonal variations on nutritional status - particular weight may be affected in a relatively short time - is believed to be cancelled out.

Baqui (1990) also calculated weight-for-age and height-for-age profiles for the under-five population. Whereas we used the CDC/WHO reference population of 1978 of US NCHS - which was closest in time to the collection of under-five data in 1988-1989 - Baqui probably used an older reference population, though also of US NCHS, published by Waterlow et al. (1977) and Hamill et al. (1979) (Zaman et al. 1996, p. 310). Our results are generally in agreement with the calculations of Baqui (1990, pp. 140-150). However, prudence is called for here because Baqui presented his results on under-five underweight and stunting in a slightly different manner. He presented the nutritional profiles for instance over four three-month intervals, distinguishing two categories (underweight versus not underweight, or <-2 SD versus ≥-2 SD). Considering the high percentages of children who are *severely* underweight and stunted (see above), we think it is more appropriate to distinguish explicitly the <-3 SD category as well. In addition, Baqui did not present the full results (tables) by sex (Baqui 1990, pp. 142-148), whereas in our view nutritional status development follows a typical sex-specific 'blueprint' and may also be gender-specific because of socio-cultural circumstances (subsection 2.3.2). Nevertheless, both our as well as

Baqui's calculations point to high proportions of underweight. Pending the three-month period considered, in Baqui's study under-five children who were underweight (<-2 SD) ranged from 73 to 78 per cent. These figures are slightly higher than the 71 and 69 per cent (*moderately* and *severely* underweight combined) that we calculated as an average for under-five boys and girls, respectively, for the whole period (1988-1989).

With regard to stunting the results also match closely, whereby it should be noted that we again found slightly lower proportions of under-five boys and girls falling in the category <-2 SD. According to Baqui's calculations, the lowest and highest proportions, again pending the three-month period considered, of stunted under-five children amount to 68 and 76 per cent, respectively. This is again slightly higher than the 64 and 67 per cent stunted children (*moderate* and *severe* combined) that we calculated as an average for the whole period (1988-1989) for under-five boys and girls separately.

The way of presenting underweight and stunting profiles by three-month periods, as done by Baqui, allows for the detection of possible associations with seasonality. Throughout the baseline survey, Baqui established weight-for-age of young children, i.e. young within the 0-5 years age group (whereby 'young' is not further defined) to vary more than weight-for-age of their older counterparts (Baqui 1990, p. 150). Weight-for-age of these younger children was relatively high in April 1988, when the baseline survey started, and lowest halfway, in September 1988. Baqui notes that no important differences by sex in this respect were found. In general, girls were lighter throughout the survey, except for the months March and April 1989 when girls appeared to have a significantly better nutritional status on average in terms of weight-for-age (Baqui 1990, p. 150). These two months fall within the dry hot period, from March to June (Fauveau 1994, pp. 13-14), and partly coincide with the *Boro* harvest, which takes place in April-May (Hellen Keller 1993, p. 5). Girls may have benefited from these favourable conditions, both in terms of 'seasonality' as well as food security. However, it does not explain why girls caught up in these months on their relative backlog, since it is plausible to assume that these conditions are beneficial for boys as well.

In sum, rather 'crude' average scores for 12-month periods show that weight, height and MUAC are higher among boys as compared to girls throughout the period of early childhood. Furthermore, age-specific underweight and stunting profiles reveal that the nutritional status of girls is less adequate than that of their male peers when the *severely* malnourished categories of underweight and stunting are considered. Adolescent boys and girls who were *severely* (<-3 SD) underweight in early childhood amount to respectively 23 and 36 per cent. Corresponding figures for childhood stunting are respectively 23 (boys) and 37 per cent (girls). Apparently, contrary to the situation in adolescence (see section 5.2), the nutritional status of girls is *less adequate* than that of boys in early childhood. This difference in early childhood nutritional status is however counterbalanced if we consider the two categories, *moderately* and *severely* underweight respectively stunting, together. According to our own calculations - and in line with what was reported by Baqui - respectively 71 and 69 per cent of the under-five boys and girls were underweight (<-2 SD) and 64 and 67 per cent of the under-five boys and girls were stunted (<-2 SD).

Comparisons over time: choice of reference population
As discussed in section 3.3, we applied the CDC reference population of 2000 and the CDC/WHO reference population of 1978 to assess nutritional status of adolescents and under-five children, respectively. Application of the CDC 2000 reference population for the assessment of nutritional status of the adolescent population in 2001 seems appropriate. After all, the standards set to assess nutritional status are to some extent time-dependent: a person, whom we consider small nowadays, may have had a 'normal' height in the eyes of people a quarter of a century ago. Application of, for instance, the CDC/WHO 1978 reference population to our adolescent population would therefore not be a valid option since these reference measurements were considered 'the standard' for adolescents about 25 years ago. Also, application of a reference population forward in time (i.e. the reference population is measured later in time than the study population, which would, for instance, be the case if we applied the CDC 2000 reference population to our under-five study population) does not make sense either as current nutritional status is likely to be different than future standards. Thus, it is important to make use of:

- *a reference population that is relevant for a particular time; and*
- *to ensure that this reference population is as close as possible in time (but preferably 'back' in time) to the year of measurement of the study population.*

When making a comparison about nutritional status back in time as we did - comparing adolescents' nutritional status with their nutritional status in early childhood - we should be aware of the fact that two reference populations are used. By applying time-specific reference populations we standardised nutritional status in both stages in life according to time-specific nutritional conditions, thus we did not standardise over time. In order to check whether it would yield any differences in distribution over the respective levels of underweight and stunting (both sexes combined) we therefore applied the CDC/WHO 1978 reference population to the adolescent study population. When we compare the distributions over three levels of height-for-age (not stunted, moderately stunted, severely stunted) calculated on the basis of the 2001 reference population with those calculated on the basis of the 1978 reference population, it appears that differences in distributions are small (respectively -1.2, 1.6, and 0.4 per cent). When we repeat this exercise for the three respective levels of underweight, we find considerable differences. The differences in distributions of not underweight, moderate and severe underweight amount to respectively -7, -30 and 37 per cent.

Thus, the high percentages of severely (<-3 SD) underweight that we found among our adolescent population are in part related to the application of the CDC 2000 reference population. If we would have used the CDC/WHO 1978 population the proportions of severely (<-3 SD) underweight would have been lower, and in turn, the proportions of moderately (between -3 and -2 SD) underweight would have been higher as compared to what is reported now. When making comparisons over time, it is not underweight but stunting that is the most relevant nutritional indicator since the former may be subject to short-term changes in weight and therefore fluctuate over time, whereas stunting is considered to be 'the nutritional lifecourse indicator'.

Now that we know the underweight and stunting profiles of the study population in early childhood as well as in adolescence, we will next explore whether and if so, in what direction, nutritional status has changed - improved or deteriorated - when we compare the stunting profiles of these two periods in life.

5.3.3 Potential to catch up early life growth faltering in adolescence

The analyses presented in this subsection are guided by hypotheses 5 and 6 that both stem from the assumption that an inadequate nutritional status in early childhood predisposes an inadequate nutritional status in adolescence. More specifically, we aim to explore:

- whether malnutrition as indicated by level of stunting is more prevalent among adolescents who were stunted in early childhood as compared to adolescents who were not stunted as an under-five (hypothesis 5);
- whether adolescents who were already stunted at the age of two years are more likely to remain stunted as compared to their not stunted same-aged counterparts in early childhood (hypothesis 6); and
- whether girls are more likely than boys to catch up early childhood growth faltering in adolescence (hypothesis 9).

Basically our aim is to gain insight into the question of whether there is any potential to catch up growth faltering due to malnutrition in early childhood, and whether this catch-up potential differs by age and sex of the child. As elaborated in Chapter 2, the potential for catch up faltering growth (stunting) in childhood is believed to be limited after the age of two years, particularly when such children remain in poor environments (Gillespie and Flores 2000, p. 2).

In the analyses, the dependent variable is *adolescent stunting* since this is caused by malnutrition over an extended period, whereas underweight is more difficult to interpret and may be due to either acute or chronic malnutrition (Leemhuis-de Regt 1998, p. 111). Also CED according to BMI Z-scores can be influenced easily by fluctuations of contemporary weight and is therefore not useful as an indicator in the study on early life origins of adolescent nutritional status. Since the analyses are based on a comparison of nutritional status in early childhood and adolescence, we cannot say anything about the level of malnutrition and possible fluctuations over time, i.e. *between* early childhood and adolescence. Finally, it should be noted that the analyses presented below provide a first glance on the association between nutritional status in childhood and adolescence. Measurements of correlation and strength of associations will be addressed in section 5.6, whereby nutritional status indicators pertaining to the respective stages in life - birth, early childhood, adolescence - are considered together.

Long-term effects of childhood stunting on adolescent stunting

Table 5.10 shows the relative improvement or deterioration with regard to level of stunting between early childhood and adolescence for boys and girls irrespective of age. The figures pertaining to early childhood reflect a ‘summary’, i.e. on the basis of a maximum of 14 anthropometric measurements, taken over an approximate two-year interval, one overall stunting profile has been assessed (see subsection 3.3.2).

Table 5.10 Distribution of adolescents by level of contemporary and early childhood stunting and sex, Matlab 1988-2001 (%)

		Childhood stunting*			
Sex	**Adolescent stunting****	**Not stunted (%)**	**Moderately stunted (%)**	**Severely stunted (%)**	**Total (%)**
Boys	Above -2 SD from median (*not stunted*)	34	17	5	21
	Between -3 and -2 SD from median (*moderately stunted)*	49	49	24	43
	Below -3 SD from median (*severely stunted)*	17	34	71	36
	n	100 (n=93)	100 (n=107)	100 (n=58)	100 (n=258)
Girls	Above -2 SD from median (*not stunted*)	54	31	12	32
	Between -3 and -2 SD from median (*moderately stunted)*	36	53	32	40
	Below -3 SD from median (*severely stunted)*	10	16	56	28
	n	100 (n=74)	100 (n=68)	100 (n=82)	100 (n=224)

** Using the CDC/WHO reference population of 1978 (US NCHS)*

*** Using the CDC reference population of 2000 (US NCHS)*

From Table 5.10 we learn that of the boys who were *severely* (<-3 SD) stunted as an under-five, 71 percent remains *severely* (<-3 SD) stunted in adolescence. The potential to catch up early childhood growth faltering is limited: respectively 5 and 17 per cent of the under-five boys who were *severely* (<-3 SD) or *moderately* (between –3 and –2 SD) are *not stunted* (>-2 SD) when they become adolescents. Of respectively 49 and 17 per cent of the *not stunted* under-five boys the stunting profile deteriorates into *moderate* and *severe* in adolescence. Compared to boys, a relatively high proportion of girls maintains an adequate nutritional status between early childhood and adolescence: 54 per cent of the girls remains *not stunted* (>-2 SD). Of almost a third of the girls, 31 per cent, the stunting profile improves from *moderately* (between -3 and -2 SD) to *not stunted* (>-2 SD). Similarly, 12 per cent of the *severely* (<-3 SD) stunted under-five girls catches up on their nutritional backlog to become *not stunted* (>-2 SD) in adolescence. Apparently, *severely* stunted under-five girls are more likely than boys to catch up early life growth faltering in adolescence. For both boys and girls the differences between the values at baseline (in early childhood) and at follow-up (adolescence) are significant (Pearson Chi-square) at a level of less than 0.0001 (p-value).

Given our interest in the question of whether the potential to catch up early life growth faltering is different for individuals who were already stunted at the age of two years as compared to their *not stunted* same-aged counterparts, we selected individuals who were enrolled at baseline at an age between one and two years, and who thus were adolescents of 14 to 15 years at follow-up. In Table 5.11 the distribution of 14 and 15-year-old adolescent boys and girls is shown by level of contemporary and early childhood stunting. We hereby defined ‘being stunted’ as a dummy variable whereby the cut-off point is above -2 SD from the median of the well-nourished reference population as indicated in the table.

Table 5.11 Distribution of adolescent boys and girls by level of contemporary stunting and stunting between the age of one and two years, Matlab 1988-2001 (%)

		Childhood stunting*		
Sex	**Adolescent stunting****	Not stunted	Stunted	Total
Boys	Not stunted (>-2 SD)	42	17	22
	Stunted (<=-2 SD)	58	83	78
	n	100 (n=26)	100 (n=107)	100 (n=133)
Girls	Not stunted (>-2 SD)	81	17	30
	Stunted (<=-2 SD)	19	83	70
	n	100 (n=26)	100 (n=96)	100 (n=122)

** Using the CDC/WHO reference population of 1978 (US NCHS)*
*** Using the CDC reference population of 2000 (US NCHS)*

From Table 5.11 we see that of the boys who were stunted at the age between one and two years, 83 per cent is stunted in adolescence as well. Of the boys who were *not stunted* (>-2 SD) as at these particular ages in early childhood, 58 per cent becomes *stunted* (≤2 SD) in adolescence. The differences are even larger for girls. Of girls who were *stunted* between one and two years, 83 per cent is also *stunted* in adolescence, whereas of girls who were *not stunted* at these particular ages in early childhood 19 per cent becomes *stunted* in adolescence. In line with previous studies that pointed out that the potential to catch up faltering growth after the age of two is limited, we find that among one to two-year-old *stunted* boys and girls only 17 per cent catches up on height. For both boys and girls the differences between the values at the age between one and two years (in early childhood) and at follow-up (adolescence) are significant (Pearson Chi-square) - for boys at a level of less than 0.01 (p-value) and for girls at a level of less than 0.0001 (p-value).

Apparently girls do *not* have a greater potential to catch up faltering growth around the age of two years as compared to their male counterparts in adolescence. However, among under-five children who did not suffer faltering growth around the age of two years - among those who were stunted - girls are less likely than boys to become stunted in adolescence. The latter finding is possibly related, as earlier suggested in section 5.2, to the earlier growth spurt among girls. Adolescent boys may have a tendency to be 'just lean' in early adolescence, i.e. up to about the age of 15 (the turning point at which boys catch up on their relative backlog in height, as we observed before in Figure 5.3) and catch up on height at a later stage in adolescence.

Next, in section 5.4, we go a little further back in time by exploring the conditions at birth in relation to the stunting profiles of boys and girls through early childhood and adolescence.

5.4 Conditions at birth and level of stunting in childhood and adolescence

Having gained some insight into the nutritional status of the study population in both adolescence as well as in childhood and in the relative change in nutritional status according to the level of stunting between these two stages in life, we continue our study by analysing data on conditions at the time of birth. First, we analyse data on age of the mother at the time the adolescent was born (subsection 5.4.1). As outlined in section 2.5, adolescent childbearing - not uncommon in Bangladesh - may entail specific risks for both the mother and child. Second, we analyse data on weight, size and timing of the birth (subsection 5.4.2). These data have been collected by means of retrospective recall from the adolescent's mother in 2001. We followed the guidelines of Demographic and Health Surveys (DHS) that indicate that in the absence of documentation on the baby's anthropometry at birth, a mother's verbal report of the child's birth weight and relative size, a report which relies on memory, is the only source available (DHS 1997, pp. 106-107).

In case it was not possible to interview the mother herself (due to death or migration for instance), where possible a proxy was interviewed, such as the adolescent's grandmother, aunt or father (see also section 3.7). Data on conditions at birth have been collected by proxy in 47 cases. In 2 cases no information about birth conditions could be provided because the adolescent was adopted at an early age. In order to get an idea about the quality of the data on *recalled* birth weight, we analysed to what extent these data corroborate with the *observed* data on anthropometric weight for the youngest children enrolled at baseline, i.e. those children who were 0 to 1 month old in 1988-1989. Finally, we relate the data on conditions at birth to the stunting profiles in early childhood and adolescence (subsection 5.4.3).

5.4.1 Age of mother at birth

As elaborated in Chapter 2 (subsection 2.5.2) young age (or rather young *gynaecological* age) is a factor that may have a detrimental influence on the course and outcome of a pregnancy, herewith placing the life of the adolescent mother herself as well as that of her baby at risk. Among the total study population considered, the mean age of the mother at the time the adolescent was born was 26.9 years with a minimum of 14 years and a maximum of 49 years (n=546). The proportion of mothers who were 19 years or younger at the time of birth was 13 per cent, whereas almost 5 per cent of the mothers was 40 years or older at the time the adolescent was born. Old age at birth is also an established risk factor for maternal mortality - particularly because of its association with multi-parity (WHO 1991, p. 6) - and is furthermore associated with lower reproductive success reflected by lower fecundity and fecundability, greater likelihood of spontaneous abortion (van der Veen 2001, pp. 110-113), and adverse birth outcomes, among which include preterm birth (den Draak 2003, p. 303). Risks to reproductive health related to higher age of the mother at birth are however not discussed because they fall outside the scope of this study. We will come back to the age of mothers at the birth of the child enrolled in our study in subsection 5.4.3 when we explore whether young maternal age at birth is associated with a greater likelihood of low birth weight, small size at birth, or early timing of the birth.

5.4.2 Recalled birth weight, birth size and relative timing of birth

Birth weight

Despite the relative long period of recall at least 56 per cent of the interviewed mothers (including proxies) of adolescents was able to report on their adolescent son's or daughter's birth weight (n=310). Naturally, one needs to practise caution in analysing data collected after such a long period of recall, although there is evidence - albeit in a Western setting - that parental recall of birth weight can be good up to 16 years after delivery, irrespective of the social class of the parents[49] (O'Sullivan et al. 2000). Additionally, as noted before, DHS studies generally rely on mothers' verbal reports of their children's anthropometric data (DHS 1997, pp. 106-107). Our data on recalled birth weight was however compromised from heaping around the weights of 2000 (33 per cent), 2500 (32 per cent) and 3000 grams (22 per cent). The universal value set for 'low birth weight' for a full-term baby is 2500 grams (ICDDR,B 2002b, p. 36). In view of the heaping, we were likely to over-represent the number of low-birth weight babies if we applied this definition (71 per cent of the reported birth weights would fall in the category of 2500 grams or less). To be on the safe side with assessing the prevalence of LBW babies among the study population, the cut-off point for low birth weight is therefore set at 2000 instead of 2500 grams. Among our study population the proportion of boys (n=173) and girls (n=137) born with a low birth weight (≤ 2000 grams) equals to respectively 39 and 40 per cent. Such proportions are

[49] O'Sullivan et al. (2000, p. 1), examining the accuracy of parental recall of the birth weight of British children ranging in age from 6 to 15 years, found that 75 per cent of the recalled birth weights were within the 50 grams of that recorded in hospitals, whereas no significant associations were found between the difference in birth weight (recalled birth weight minus hospital record) and social class of the parents or age of the child at the time of data collection.

high because "in a normal population 4 to 7 per cent of the babies are born with a low birth weight; in developing countries this proportion may be between 15 to 20 per cent, rising to 30 per cent in exceptional cases" (Leemhuis-de Regt 1998, p.112). Our results are lower than the overall 45 to 50 per cent usually reported with respect to LBW babies in Bangladesh (ICDDR,B 2002b, p. 36). However, our data are not comparable with those published by ICDDR,B since their data are based on a cut-off point of 2500 grams.

In order to get an idea about the quality of the data on *recalled* birth weight from 2001, we analysed to what extent these data corroborate with the *observed* data on anthropometric weight of the youngest children enrolled at baseline, i.e. those children who were 0 to 1 month old in 1988-1989 (n=26). Table 5.12 shows the distribution of these children by recalled birth weight and observed weight at baseline. Even if we consider that children generally gain weight in the first month after birth, the table indicates that recalled birth weight is considerably lower than the observed weight in the first weeks of life. For instance, of the children who weighed between 3600 and 4000 grams at baseline, 60 per cent had a birth weight as recalled by the mother of 2000 grams. As noted, the sample of 26 cases is small. If this small sub-selection of cases would be representative for all cases of whom recalled birth weight is known (n=310), the figures on (recalled) birth weight seem to be underestimated. We also looked at *Pearson's* correlation coefficient, a measure of linear association between two variables, among the larger sample (n=310). It appears that observed weight at baseline and recalled birth weight are indeed highly significantly correlated ($p<0.01$), although the correlation coefficient is relatively small, i.e. 0.18.

Table 5.12 Distribution of 0 to 1-month-old children by weight as observed at baseline and by birth weight as recalled from 2001 in the follow-up survey, Matlab 1988-2001 (%)

Observed weight	Birth weight (in grams) as recalled from 2001				
(in grams) at baseline	2000	2500	3000	3500	total
2600-3500	62	25	0	13	100 (n=8)
3600-4000	60	20	20	0	100 (n=10)
4100-4900	24	38	38	0	100 (n=8)

Relative size at birth

The proportion of the children who were born respectively normal, small or tall in size (relative to other babies according to the mother's or proxy's retrospective recall) amounts to 62, 23 and 15 per cent (n=550). Given the potential errors related to the long-term recall of the mothers, these figures as such are quite arbitrary and not useful in the comparison with data of other populations. It appears furthermore that babies who were born small in size constituted 19 per cent among baby boys (n=301) and 28 per cent among baby girls (n=249). It is highly unlikely that this apparent difference is wholly attributable to biological factors per se. We also do not have reason to believe that there are any sex-specific systematic errors in the data. Instead, this difference may be related to cultural beliefs about desirable physical or bodily appearances for boys and girls, starting from birth onwards. Possibly, mothers expected their baby girl to be born smaller as compared to a baby boy. As noted by Blanchet (1996, p. 51), while citing a *dai* who discusses practices around birth that emphasise the inferiority of girls, "boys should be ahead of girls in everything they (i.e. boys) do". Mothers may therefore have had a tendency to report relatively more often that their daughter was small at birth, in line with what they expected or hoped for.

Relative timing of birth

Regarding data on the recalled approximate timing of the birth, again by the mother or a proxy, it was reported that 79 per cent of the children was born 'on time' against 20 per cent 'early' births (or premature[50]) (n=541). The proportion of 'late births' is negligible. The children who were reported to be born 'early' were believed to be born on average[51] 3.1 weeks before their due date (n=106). Among the cases of 'early' births there are relatively more boys (63 per cent) than girls.

5.4.3 Conditions at birth as predictors for stunting later in life

Age of mother and weight, size and timing of birth

Table 5.13 shows the distribution of babies according to their recalled birth weight, size and relative timing at birth over three age groups, indicating the mother's age at birth of the child. The three conditions at birth - birth weight, size at birth and timing of birth - are presented in a binary manner. From Table 5.13 we see that in general the distribution across the three maternal age groups is rather similar and does not discriminate convincingly for any of the three conditions at birth.

Table 5.13 **Distribution of study population by age of mother and conditions at birth, Matlab 2001 (%)**

	Age of mother at birth (in years) 19 or younger (%)	20 to 39 (%)	40 or older (%)	Total (%)
Recalled birth weight				
>2000 grams	61	60	56	60
<=2000 grams	39	40	44	40
n	100 (n=49)	100 (n=243)	100 (n=18)	100 (n=310)
Recalled size at birth				
Not small	74	78	76	77
Small	26	22	24	23
n	100 (n=72)	100 (n=449)	100 (n=29)	100 (n=550)
Recalled timing of birth				
Not early	76	80	82	80
Early	24	20	18	20
n	100 (n=72)	100 (n=442)	100 (n=27)	100 (n=541)

[50] We do not use the term 'premature' because this is based on the counted number of weeks of gestation. Our data reflect the timing of the birth as perceived by the adolescents' mothers (and are assessed on the basis of retrospective recall in 2001; see also section 3.3).

[51] Three cases (babies who were reported to be born 6 to 8 weeks early) have been excluded from the calculation of the average, since it is unlikely that such premature babies could have survived without incubators and advanced medical assistance.

Young gynaecological age

As has been elaborated in section 2.5.2, it is not *chronological* age but rather *gynaecological* age (age since menarche) that may be important for the course and outcome of a pregnancy. However, we do not know whether adolescents enrolled in our data-base were the *first* child born to their mother. Subtraction (maternal age at birth minus age at menarche) does not give an accurate indication of a mother's genuine *gynaecological* age at first birth. Given our interest in adolescent mothers though, we selected those mothers whose age at birth of the child *enrolled in our study* was 19 years or younger and calculated their *gynaecological* age as maternal age at birth minus age at menarche. Such a sub-selection generated too few cases (n=39) on which to base a multivariate analysis, but it is worthwhile noting that within this group the *gynaecological* age varied from 0 to 7 years, meaning that the gap between the reaching of menarche and the birth of the child was 7 years at the most. When we look at the cumulative proportions, it appears that no less than 20 per cent of these adolescent mothers gave birth within two years after reaching menarche, whereas 44 per cent became a mother within 3 years after menarche.

Small maternal height and low birth weight

The risk of low birth weight is also known to be higher among women of small stature (DHS 2001). Cross-tabulating recalled birth weight with maternal height (not shown; n=300), whereby the cut-off point is set at 145 cm (the earlier mentioned cut-off point for obstetric risk, see section 5.2) did however not show any appreciable difference between the proportions of children born with a birth weight of 2000 grams or less among mothers who were shorter than 145 cm. It appeared that 53 per cent of the children born to these small mothers had a low weight at birth, against 35 per cent of the children born to the group of mothers whose height was 145 cm or more.

Weight and size at birth versus level of stunting in early childhood and adolescence

Next, we briefly explore to what extent recalled weight and size at birth may have formed a predisposition to nutritional status, as indicated by the level of stunting, in childhood and adolescence, respectively (Table 5.14). We are particularly interested in possible effects of conditions at birth on stunting status in later life that may entail a higher risk, i.e. being born with a birth weight of 2000 grams or less and being born small in size.

Table 5.14 **Distribution of adolescents by recalled weight and size at birth and level of contemporary* and early childhood** stunting, Matlab 1988-2001 (%)**

	Not stunted		Moderately stunted		Severely stunted		Total	
	adolescence	childhood	adolescence	childhood	adolescence	childhood	adolescence	childhood
Recalled birthweight								
>2000 grams	21	35	46	36	32	30	100 (n=108)	100 (n=121)
<=2000 grams	34	35	40	36	27	28	100 (n=164)	100 (n=187)
n	78	108	115	111	79	89	272	308
Recalled size at birth								
Not small	27	37	42	35	30	28	100 (n=371)	100 (n=419)
Small	20	26	40	33	41	40	100 (n=111)	100 (n=126)
n	124	187	201	188	157	170	482	545

* *Using the CDC reference population of 2000 (US NCHS)*
** *Using the CDC/WHO reference population of 1978 (US NCHS)*

From Table 5.14 we see that a birth weight of 2000 grams or less *hardly* differentiates between level of stunting in adolescence, and it does *not* diferentiate between level of stunting in early childhood. For example, of the children born with a low weight, 34 per cent was *not stunted* (>-2 SD) in adolescence as opposed to 40 per cent *moderately* (between -3 and -2 SD) and 27 per cent *severely* (<-3 SD) stunted. Of the children born with a low weight at birth, 35 per cent is *not stunted* in early childhood compared to 36 per cent *moderately* and 28 per cent *severely* stunted. Children born small in size may be somewhat more likely to be *moderately* or *severely* stunted in adolescence. For instance, among this group of babies, almost 20 per cent is *not stunted* (>-2 SD) in adolescence against 40 and 41 per cent respectively who are *moderately* (between -3 and -2 SD) and *severely* (<-3 SD) stunted. Having a small size at birth differentiates less between the respective levels of stunting in early childhood.

In order to test whether size at birth is truly associated with stunting status in adolescence, it is necessary to adjust for early childhood stunting status as a possible effect of size at birth on the likelihood of being stunted in adolescence. Nutritional status is also an important consideration when studying further the relation between birth weight and adolescent stunting. Although the descriptive findings discussed so far may not seem to show an effect, it could be possible that LBW babies are more likely to catch up on their relative backlog in early childhood. These possible associations are studied more thoroughly in section 5.6 by means of multivariate regression analyses, whereby we will take into account the interrelationships between the contemporary and early life nutritional predictors of adolescent nutritional status.

5.5 The intergenerational perspective: maternal nutritional anthropometry

Central to this section is the nutritional status of the adolescents' mothers, as indicated by their weight, height and MUAC (subsection 5.5.1) and Body Mass Index (5.5.2). Maternal anthropometry has been assessed in 2001. In order to answer the question to what extent an impaired nutritional status is 'embodied', i.e. passed on from one generation to the next, we linked maternal anthropometry to that of the study population in adolescence and early childhood (subsection 5.5.3). We looked at *stunting status* of the adolescent child because this indicator is known to be influenced by malnutrition over generations (Leemhuis-de Regt 1998, p. 111) and *height of the mother*. In contrast to BMI, which is subject to fluctuations in weight, *height* can considered to be stable from adulthood onwards. Data on maternal anthropometry are available for almost 70 per cent of the mothers. Reasons why not of all mothers' anthropometric measurements were taken were that they were not available (71 per cent of all missing cases) or some mothers refused to be measured (29 per cent of all missing cases).

5.5.1 Maternal weight, height and MUAC

Weight and height

Regarding the basic measurements, weight and height, we found the mean, lowest and highest scores for mothers to be 42.4, 28.2 and 66.6 kg (weight; n=491) and 149.5, 135.2 and 165.8 cm (height; n=492), respectively.

Obstetric risks according to weight and height

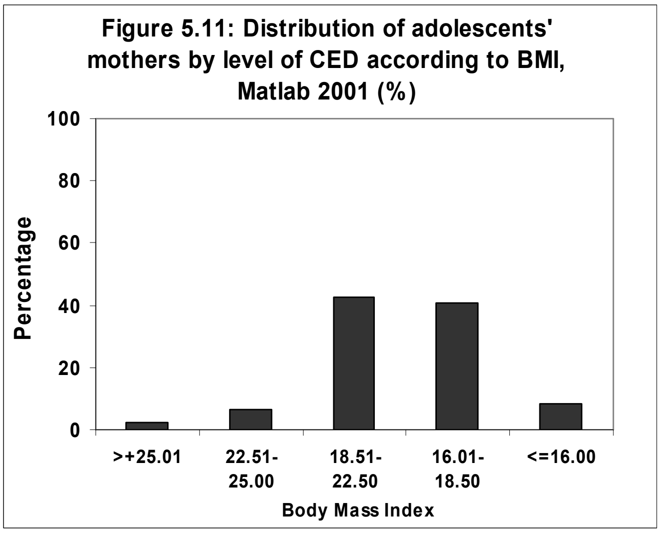
Considering the cut-off points of obstetric risk (a weight below 45 kg and a height below 145 cm; WHO 2003, p. 22) a closer look at the data tells us that 71 per cent of the mothers would currently be at risk because of low weight and 16 per cent because of their short stature. We should note however that - in contrast to adult height - weight can fluctuate considerably over time. Since a mother's weight is measured at the time of the follow-up survey in 2001 we cannot claim that 71 per cent of the adolescents were born to *severely* malnourished mothers in terms of weight. In theory these low-weight mothers may have had adequate weights some 13 years ago when their son or daughter, who is currently enrolled in our study, was born. However, if these mothers would become pregnant now they would indeed face severe obstetric risks. A considerably smaller proportion of the mothers is at risk because of their short stature. We assume that adult height remains stable over time and that a mother's height measured in the follow-up survey is similar to, or at least approaches, height at the time the adolescent was born. However, we should take into account that some mothers (13 per cent, n=546; see section 5.4) were adolescents themselves (i.e. 19 years or younger), at the time they gave birth to their - now - adolescent son or daughter and hence, therefore not likely to have had completed their growth curve at that time. The youngest mother in our sample was 14 years and the majority of the 'adolescent mothers' were 18 years at the time of birth of their child. Among the group of adolescent mothers, 13 per cent is currently, and thus certainly at the time of the adolescent's birth, *shorter* than 145 cm. This finding does however not mean that the remaining 87 per cent of the mothers was 145 cm or *taller* when they gave birth. Their height as well may have been below the critical cut-off point, but they may have caught up on their height after the birth of their child. The latter would be in agreement with an observation of Riley (1994, p. 92) that in some adolescent girls and young women in Matlab linear growth continued past the age of 20 years (subsection 2.5.2).

Mid-upper arm circumference

MUAC is an emergency measurement whereby a MUAC of less than 22.5 indicates *severe* malnutrition in adults (Leemhuis-de Regt 1998, p. 112). We found that 22 per cent of the mothers of the adolescents falls below this cut-off point. MUAC is also used for the screening of pregnant women because malnourished women are at greater risk of having a LBW baby. At the moment of survey, however, only one mother appeared to be pregnant and her nutritional status appeared to be adequate (irrespective of the type of indicator - weight, height, MUAC or BMI - used).

5.5.2 Maternal Body Mass Index

Figure 5.11 shows the distribution of scores on the BMI scale of the mothers of the adolescents. As indicated in section 3.3, the lower and upper cut-off points for what is considered a healthy BMI are 18.5 and 25.0 respectively. A score lower than 18.5 indicates that an adult is in a malnourished state and a score below 16.0 indicates *severe* underweight (or *severe* CED). At the other end of the spectrum, a score higher than 25.0 means overweight and a score greater than 30.0 is a reflection of severe overweight or obesity.



From Figure 5.11 we see that a large proportion of the adolescents' mothers, 49 per cent, is currently not undernourished according to BMI. A few mothers, 2 per cent, is slightly overweight. A considerable proportion of the mothers is malnourished according to BMI: 41 per cent is underweight and 8 per cent is *severely* underweight. This proportion is slightly higher as compared to results published by DHS for Bangladesh (2001), who reported 45 per cent of the mothers to have a BMI below 18.5.

The *severely* underweight mothers in our sample are not considerably smaller than the other mothers, but are indeed relatively light. Weight can fluctuate over time rather quickly for instance in times of sickness. Weight typically decreases rapidly in cases of diarrhoea. Although we did not examine the mother's overall health status nor ask the mothers to report on their health status themselves (self-reported health status), we found none of the mothers enrolled that ill that she could not be interviewed or have her anthropometric measurements taken.

5.5.3 Height of mother and stunting status of her child

In this section we briefly explore the relationship between height of mother and the level of stunting of her child in adolescence (Table 5.15) and early childhood (Table 5.16).

Table 5.15 **Distribution of adolescents by level of contemporay stunting*, sex and height of the mother, Matlab 2001 (%)**

Sex	Maternal height (in cm)	Level of stunting: Not stunted	Moderate	Severe	Total
Boys	shorter than 145 cm	11	36	53	100 (n=36)
	145 cm or taller	23	44	33	100 (n=199)
	n	50	100	85	235
Girls	shorter than 145 cm	12	41	47	100 (n=41)
	145 cm or taller	37	40	23	100 (n=163)
	n	65	83	56	204
Total	shorter than 145 cm	12	39	49	100 (n=77)
	145 cm or taller	29	43	28	100 (n=362)
	n	115	183	141	439

** Using the CDC reference population of 2000 (US NCHS)*

Table 5.15 shows that small mothers are more likely to have a child who is *severely* stunted in *adolescence* as compared to mothers who are not small. For instance, among the group of adolescents who have a small mother (i.e. shorter than 145 cm), 49 per cent is *severely* (<-3 SD) stunted. Adolescents with taller mothers account for 28 per cent. When we look at the data broken down by sex, we see that this difference in adolescent stunting status is slightly larger among boys: respectively 53 per cent of the boys with a small mother is *severely* stunted as compared to 33 per cent among the boys whose mother is taller. The corresponding figures for girls are respectively 47 against 23 per cent.

From Table 5.16 we find that small mothers are also more likely to have a child who is *severely* stunted in *early childhood* as compared to mothers who are not small. Among girls with a mother who is less than 145 cm tall, 61 per cent is *severely* (<-3 SD) stunted and 7 per cent *not stunted* (>-2 SD). Such a difference in early childhood stunting status is not found among girls whose mother is 145 cm or taller. The apparent influence of maternal height on stunting status of her adolescent child is likely to be confounded by early life nutritional status. In section 5.6 we will further study the effect of maternal height on adolescent stunting while controlling for early life nutritional status (at birth and in early childhood) by means of regression analyses.

Table 5.16 Distribution of adolescents by level of childhood stunting*, sex and height of the mother, Matlab 1988-2001 (%)

Sex	Maternal height (in cm)	Level of stunting Not stunted	Moderate	Severe	Total
Boys	shorter than 145 cm	30	35	35	100 (n=43)
	145 cm or taller	37	39	24	100 (n=224)
	n	96	102	69	267
Girls	shorter than 145 cm	7	32	61	100 (n=44)
	145 cm or taller	39	30	31	100 (n=177)
	n	72	67	82	221
Total	shorter than 145 cm	18	33	49	100 (n=87)
	145 cm or taller	38	35	27	100 (n=401)
	n	168	169	151	488

** Using the CDC/WHO reference population of 1978 (US NCHS)*

5.6 Multi-lifecourse nutritional predictors of adolescent stunting

Studying adolescents' reproductive health by taking explicitly into account the nutritional status career implies a retrospective approach to the course of life as adolescent nutritional status is impacted by nutritional and health conditions in childhood and even before that: at birth and during the period of gestation (section 2.3). Also, adolescent nutritional status is important for health later in life and to that of the future offspring (section 2.5). In this section we study how stunting status in adolescence (the dependent variable) is predisposed by nutritional status earlier in life, height of the mother, and sex of the adolescent. Based on the literature review (see aforementioned sections), we selected adolescent stunting or height-for-age to be the dependent variable because of its relation with pelvic size. Height may, more than weight, be important for reproductive health of adolescent girls and young women.

Firstly, the strengths and directions of correlation between the dependent and the independent variables are assessed (subsection 5.6.1). Thereafter, multiple regression techniques are applied to determine the influence of a predictor (explanatory factor or covariate) on 'adolescent stunting', the dependent variable (subsection 5.6.2). The multiple regression model predicts the presence of stunting. It includes several covariates ($x_1 \ldots x_p$), which are in our study indicators of nutritional anthropometry at various moments in life. We applied binary logistic regression analyses in two steps. First, univariate regression models are specified to determine the effects of each potential predictor separately. Secondly, multivariate models are formulated to determine whether the effect of a potential predictor changes in the presence of other predictors of nutritional status in previous stages in life.

5.6.1 Strengths and directions of correlation

In this subsection we explore the strengths and directions of correlation between the dependent and the independent variables. We hereby also look at multi-collinearity i.e. correlation between the respective independent variables, particularly those that pertain to the same stage in life (for instance, adolescent underweight, adolescent stunting and adolescent BMI). The dependent and independent variables that we consider are respectively:

- adolescent stunting or height-for-age (categorical, dichotomous i.e. 0 = *not stunted* or >-2 SD; 1 = *stunted* or ≤-2 SD);
- adolescent weight and height (irrespective of age) (continuous);
- adolescent underweight or weight-for-age (categorical, 1 = *not underweight* or >-2 SD from the median; 2 = *moderately* underweight or between -3 and -2 SD from the median; 3 = *severely* underweight or <-3 SD from the median);
- adolescent Chronic Energy Deficiency according to BMI Z-scores (categorical, 1 = *not CED* or >-2 SD from the median; 2 = *moderately* CED or between -3 and -2 SD from the median; 3 = *severely* CED or <-3 SD from the median);
- childhood underweight and stunting (categorical, 1 = *not underweight* respectively *not stunted* or >-2 SD from the median; 2 = *moderately* underweight respectively stunted or between -3 and -2 SD from the median; 3 = *severely* underweight respectively stunted or <-3 SD from the median);
- recalled birth weight[52] (categorical, dichotomous i.e. 0 = 2000 grams or less; 1 = more than 2000 grams);
- recalled size at birth (categorical, dichotomous i.e. 0 = not small; 1 = small);
- maternal height (categorical, dichotomous i.e. 0 = <145 cm; 1 = ≥145 cm); and
- adolescent's sex (categorical, dichotomous i.e. 0 = female; 1 = male).

It should be noted that because of the shortcomings with regard to quality of the data - related to subjectivity and the long period of recall - on approximate timing at birth (see section 5.4), we do not take into account this variable. Birth weight and size at birth are considered although, for aforementioned reasons, some prudence is called for here as well. A test on the *validity* of the data on *recalled* birth weight by relating

[52] All under-fives and adolescents whose anthropometric data and recalled birth weight were known are included in the analyses (respectively 308 and 272 cases). The causes of low birth weight may however differ: respectively 17 and 16 per cent of these under-fives and adolescents had a low birth weight in conjunction with an early (recalled) timing of the birth (so they are probably light because of a young gestational age).

them to *observed* weight among the youngest children enrolled at baseline (i.e. those children who were 0 to 1 month old) suffered from the small numbers of the sub-sample. If this small sub-selection of cases would be representative for all cases of which recalled birth weight is known (n=310), the figures on (recalled) birth weight seem to be underestimated. Furthermore, we excluded 'MUAC in childhood' because it merely reflects current nutritional status (*at that time,* thus in childhood) and is not likely to have a long-term influence on nutritional status in adolescence.

Table 5.17 shows the (bivariate) correlation matrices of adolescent stunting (*stunted* versus *not stunted*) of the adolescent boys and girls in our sample with the selected predictors (in order of appearance in the previous sections). In general, three correlation coefficients can be distinguished: *Pearson's* coefficient, a measure of linear association between the variables; *Spearman's rho,* a measure of association between rank orders (numeric data only); and *Kendall's tau-b* coefficient, a measure of association for nominal data. Since adolescent stunting is a dichotomous variable, we used *Kendall's tau-b* coefficient to indicate its strengths and directions of correlation with potential predictors. Levels of significance are indicated by p-values. A p-value less than 0.01 and 0.05 indicates a significant statistical correlation between two variables considered (indicated in the table by asterisks).

Table 5.17 Strengths and directions of correlation between dependent variable and selected predictors, Matlab 1988-2001

	Adolescent				Childhood		Recalled		Maternal	
Variables	weight	height	underweight	BMI	underweight	stunting	birth weight	birth size	height	Sex
Adolescent stunting	**-0.391****	**-0.487****	**0.555****	**0.197****	**0.191****	**0.294****	**-0.132***	0.074	**-0.152****	**0.118****
N	485	485	485	485	482	482	272	482	439	485
Adolescent weight		**0.692****	**-0.553****	**-0.449****	-0.047	0.015	**0.192****	**-0.118****	**0.102****	**-0.115****
N		485	485	485	482	482	272	482	439	485
Adolescent height			**-0.429****	**-0.177****	-0.028	-0.055	**0.167****	**-0.112****	**0.138****	-0.036
N			485	485	482	482	272	482	439	485
Adolescent underweight				**0.566****	**0.269****	**0.249****	**-0.185****	**0.131****	**-0.112***	**0.213****
N				485	482	482	272	482	439	485
Adolescent BMI Z-scores					**0.204****	**0.083***	-0.098	**0.103***	-0.033	**0.237****
N					482	482	272	482	439	485
Childhood underweight						**0.652****	-0.082	**0.172****	**-0.184****	-0.012
N						699	308	545	488	699
Childhood stunting							-0.011	**0.111****	**-0.181****	-0.050
N							308	545	488	699
Recalled birth weight								**-539****	**0.135***	0.009
N								310	300	310
Recalled size at birth									-0.079	**-0.100***
N									492	550
Maternal height										0.049
N										492

* **Correlation is significant at the 0.05 level (2-tailed).**
** **Correlation is significant at the 0.01 level (2-tailed).**

From the correlation matrix we gather that among the adolescent boys and girls in our sample:

- Adolescent stunting or height-for-age is (highly) significantly correlated with all other nutritional indicators pertaining to the adolescent period (i.e. adolescent weight, height, underweight and CED according to BMI Z-scores). The significant correlation of adolescent stunting with adolescent weight and height is negative, meaning that the lower an adolescent's weight and height is, the more likely he or she is *stunted*, i.e. short for his or her age in comparison with a well-nourished reference population (see also subsection 5.2.2). The significant correlation of adolescent stunting with adolescent underweight and CED according to BMI Z-scores is positive, meaning that the less adequate an adolescent's nutritional status is according to these two indicators, the more likely that he or she is *stunted*.

- Adolescent stunting is (highly) significantly correlated with early childhood underweight and stunting (positive), meaning that the less adequate an adolescent's nutritional status in early childhood according to the level of underweight and stunting at that time, the more likely it is that he or she is *stunted* in adolescence.

- Adolescent stunting is significantly correlated with recalled birth weight (negative), meaning that a birth weight of 2000 grams or less is correlated with a greater likelihood of stunting in adolescence.

- Adolescent stunting is (highly) significantly correlated with maternal height (negative), meaning that small mothers, i.e. mothers whose height is below 145 cm, are more likely to have an adolescent son or daughter who is *stunted*.

- Adolescent stunting is (highly) significantly correlated with the sex of the adolescent (positive), meaning a boy is more likely than a girl to be *stunted* in adolescence.

All these correlations are in line with the descriptive analyses presented in the previous sections. Some of the independent variables are strongly correlated with each other (multi-collinearity). Collinearity between some of the variables is expected. For example, *adolescent weight* and *height* are for instance (highly) significantly correlated with each other (positive), meaning that an adolescent who weighs more is also taller and vice versa. Also *early childhood underweight and stunting* are (highly) significantly correlated with each other (positive). Similarly, it is not surprising that *recalled weight* and *size at birth* are (highly) significantly correlated with each other (negative), meaning that children born with a birth weight of 2000 grams or less were more likely to be small at birth. Collinearity may also be due to the fact that measurements are based on the same anthropometric indices. For instance, *adolescent underweight* and *adolescent CED according to BMI Z-scores* are both in part based on adolescent weight and hence, not surprisingly, also (highly) significantly correlated with each other (positive).

However, collinearity is also present between indicators of nutritional status pertaining to different stages in life, for instance:

- *Early childhood underweight and stunting* are (highly) significantly correlated with adolescent underweight and BMI (positive), meaning that the less adequate an adolescent's nutritional status was in early childhood (as measured by the level of underweight and stunting at that time), the more likely it is that he or she is *underweight* or chronically energy deficient according to *BMI Z-scores* in adolescence.

- *Recalled birth weight* is (highly) significantly correlated with adolescent weight and height (positive), meaning that children born with a birth weight of 2000 grams or less are more likely to have a lower weight and height in adolescence as compared to their counterparts who were heavier at birth.

- *Recalled size at birth* is also (highly) significantly correlated with adolescent weight and height (negative), meaning that children who were small at birth are more likely to have a lower weight and height in adolescence as compared to their counterparts who were tall at birth. *Recalled size at birth* is also (highly) significantly correlated with early childhood underweight and stunting (positive), meaning that children who were small at birth are more likely to have a low nutritional status in early childhood according to the level of underweight and stunting at that time as compared to their counterparts who were tall at birth.

- *Maternal height* is (highly) significantly correlated with adolescent weight and height (positive), meaning that small mothers, i.e. mothers with a height below 145 cm, are more likely to have an adolescent son or daughter of lower weight and height. *Maternal height* is also (highly) significantly correlated with early childhood underweight and stunting (negative), meaning that small mothers, i.e. mothers who are shorter than 145 cm, are more likely to have a son or daughter with a low nutritional status in early childhood according to the level of underweight and the level of stunting at that time. Finally, *maternal height* is significantly correlated with recalled birth weight (positive), meaning that small mothers, i.e. mothers who are shorter than 145 cm, are more likely to have a child born with a weight at birth of 2000 grams or less.

- The sex of the adolescent is (highly) significantly correlated with all indicators of nutritional status in adolescence (except for adolescent height) in such a way that a boy is more likely to have a low nutritional status than a girl in adolescence. Neither a significant correlation is found between sex and indicators of nutritional status in early childhood, nor between sex and recalled weight at birth. The sex of the adolescent is however significantly correlated with recalled size at birth (negative), meaning that - according to the mother's recall - a girl was more likely to be small at birth than a boy.

In sum, the strengths and directions of the correlation table are either as expected (for instance those variables that pertain to the same period in life) and merely confirm the results presented in the previous sections 5.2 to 5.5 (for instance, the correlation between adolescent stunting on the one hand and early childhood underweight and stunting, and maternal height on the other). Given that adolescent stunting, the dependent variable, is significantly correlated to almost all predictors included in the model, we are particularly interested in the regression models (presented next in subsection 5.6.2) whereby we review the effect of one predictor while controlling for possible confounders.

5.6.2 Logistic regression analyses

By applying binary logistic regression models we aim to build up a 'stunting profile' to determine which adolescents, given a series of indicators pertaining to nutritional status earlier in life, are most likely to be stunted. We should note that although adolescent stunting appeared to be highly correlated with adolescent underweight and BMI (see previous section 5.6.1), these two indicators could not have influenced adolescent stunting since the anthropometric values on which they are based are taken at the same time. Hence, adolescent underweight and BMI are excluded from the regression models. Additionally, since recalled size at birth did not appear to be significantly correlated with adolescent stunting (see Table 5.17), this variable is excluded as well.

In Table 5.18, the effects of single independent variables or covariates are shown (*univariate* model), meaning that every independent variable (respectively early childhood underweight, early childhood stunting, recalled birth weight, maternal height, and sex of the adolescent) is analysed separately in relation to the dependent variable (adolescent stunting). In a second step, in Table 5.19, we controlled for independent variables (*multivariate* analyses). In the models, the independent variables or covariates are *categorical* (see also subsection 5.6.1). The categories are compared to the reference category (*ref.*), whereby the latter encompass boys and girls who were respectively *not malnourished* in childhood according to anthropometry, who had a birth weight *above 2000 grams*, or who have a mother who is *145 cm or taller*.

The logistic regression coefficients are used to estimate the *constant* (odds of being stunted for the reference category) and the *odds ratios*. The odds ratio is the ratio of the odds that an adolescent who shows signs of nutritional deficiencies is stunted relative to the odds that an adolescent who has no signs of nutritional deficiencies (reference category) but is stunted. To illustrate the odds ratio, we consider the relation between stunting in early childhood and stunting in adolescence. The odds ratio is the ratio of the odds of being stunted in adolescence for those who were stunted in childhood, and the odds of being stunted in adolescence for those who were not stunted in childhood. In the *multivariate* models the likelihood ratio (*–2 log likelihood*) tells us to what extent a model significantly ‘improves’ as compared to a previous model. The performance of the model is measured in terms of its ability to predict the data from a set of predictor variables. *Nagelkerke’s* R^2 indicates the percentage of variance in the dependent variable (stunting in adolescence) explained by the predictors (independent variables) included in the model. In both the univariate and the multivariate models, the level of *significance* of the parameter considered is expressed by p-values (indicated in the table by asterisks).

Table 5.18 Binary logistic univariate regression models: odds ratios (with 95% CI) of adolescent stunting (total and by sex), Matlab 1988-2001

Predictors		Odds ratio	Constant	Nagelkerke R^2
Childhood underweight (weight-for-age)				
Total	Not underweight: > -2 SD *(ref)*	1.00	**1.685****	0.060
	Moderately underweight: -3 to -2 SD	**1.75* (1.10-2.78)**		
	Severely underweight: < -3 SD	**3.56*** (1.99-6.36)**		
Boys	Not underweight: > -2 SD *(ref)*	1.00	**2.800*****	0.022
	Moderately underweight: -3 to -2 SD	1.39 (0.71-2.72)		
	Severely underweight: < -3 SD	2.32 (0.94-5.73)		
Girls	Not underweight: > -2 SD *(ref)*	1.00	**1.029**	0.126
	Moderately underweight: -3 to -2 SD	1.94 (0.99-3.81)		
	Severely underweight: < -3 SD	**5.51*** (2.54-11.94)**		
Childhood stunting (height-for-age)				
Total	Not stunted: > -2 SD *(ref)*	1.00	**1.319**	0.142
	Moderately stunted: -3 to -2 SD	**2.64*** (1.65-4.23)**		
	Severely stunted: < -3 SD	**7.40*** (3.87-14.15)**		
Boys	Not stunted: > -2 SD *(ref)*	1.00	**1.906****	0.127
	Moderately stunted: -3 to -2 SD	**2.59** (1.34-5.03)**		
	Severely stunted: < -3 SD	**9.61*** (2.79-33.18)**		
Girls	Not stunted: > -2 SD *(ref)*	1.00	0.850	0.191
	Moderately stunted: -3 to -2 SD	**2.63** (1.32-5.24)**		
	Severely stunted: < -3 SD	**8.47*** (3.79-18.93)**		
Birth weight				
Total	> 2000 grams *(ref)*	1.00	**1.982*****	0.026
	<= 2000 grams	**1.86* (1.06-3.28)**		
Boys	> 2000 grams *(ref)*	1.00	**2.792*****	0.013
	<= 2000 grams	1.60 (0.72-3.56)		
Girls	> 2000 grams *(ref)*	1.00	**1.355**	0.044
	<= 2000 grams	2.21 (0.99-4.93)		
Maternal height				
Total	145 cm or taller *(ref)*	1.00	**2.415*****	0.038
	Shorter than 145 cm	**3.13** (1.51-6.50)**		
Boys	145 cm or taller *(ref)*	1.00	**3.326*****	0.019
	Shorter than 145 cm	2.41 (0.81-7.16)		
Girls	145 cm or taller *(ref)*	1.00	**1.717*****	0.070
	Shorter than 145 cm	**4.19** (1.56-11.27)**		
Sex of the child				
Total	Male *(ref)*	1.00	**3727*****	0.020
	Female	**0.58**(0.39-0.88)**		

**** P < 0.05; ** P < 0.01; *** P < 0.001***

In table 5.18 the odds ratios are shown - generated by the *univariate* model - for the likelihood of being stunted in adolescence by respectively level of childhood underweight and stunting, birth weight, maternal height and sex of the adolescent. The odds ratios are also estimated for boys and girls separately. In the table we observe the following:

- There is a significant effect of underweight in childhood on stunting status in adolescence. The odds of being stunted in adolescence for children who were *moderately* underweight in childhood is 1.75 times the odds for children who had a normal weight according to their age and sex in childhood (reference category). In addition, the odds ratio is considerably higher for adolescents who were *severely* underweight in childhood (3.56). When the data are broken down by sex, the results lose significance for both boys and girls who were *moderately* underweight in early childhood, whereas they remain to be significant for *severely* underweight *girls*. This indicates that for girls, childhood underweight is a better predictor of adolescent stunting than it is for boys.

- What really stands out is the highly significant ($p<0.001$) effect on the odds of being stunted in adolescence for children who were *moderately* and *severely* stunted in childhood as compared to children who had a normal height according to their age and sex in childhood (i.e. the *not stunted* under-fives). This effect remains significant when the data are broken down by sex. The odds of being stunted in adolescence - irrespective of sex - for children who were *moderately* stunted in childhood is 1.64 times the odds for children who were *not stunted* in childhood, whereas the odds of being stunted in adolescence for children who were *severely* stunted in childhood is even 7.40 times the odds for children who were *not stunted* in childhood (reference category).[53]

- There is also a significant effect of low recalled birth weight on stunting status in adolescence, whereby the odds of being stunted in adolescence for children who were born with a *birth weight of 2000 grams or less* is 1.86 times the odds for children who were born with a birth weight of more than 2000 grams (reference category). This effect loses significance when the analysis is repeated for adolescent boys and girls separately (possibly due to the decrease in sample size).

- With regard to the effect of maternal height on the odds of being stunted in adolescence, we also find a (highly) significant figure. However, this effect is again no longer significant when the data are analysed for the two sexes separately. The odds of being stunted in adolescence for children (boys and girls considered together) who have a *mother of short stature* (<145 cm) is as high as 3.13 times the odds for children who have a taller mother (≥145 cm) (reference category).

[53] The observation that the odds ratios for boys and girls combined (total) is slightly higher (for *moderately* stunted under-fives) and lower (for the *severely* stunted under-fives) than the odds ratios for boys and girls separately may be related to the distribution 'stunted versus not stunted' in adolescence for those children who were *not stunted* as an under-five child. The odds that these children are stunted in adolescence is 0.7 for boys and 0.5 for girls.

- Finally, the sex of the adolescent appeared to be a highly significant predictor of stunting status in adolescence. The odds of being stunted in adolescence for *girls* is 0.58 times the odds for boys (the reference category), meaning that girls are less likely than boys to be stunted in adolescence.

The highest *Nagelkerke* R^2 found is the one pertaining to childhood stunting: 0.142 for all children (and 0.191 for girls). This figure means that 14.2 per cent of the variation in stunting in adolescence is explained by childhood stunting only. For girls, this variable explains 19.1 per cent of the variation in adolescent stunting.

Table 5.19 shows the most salient *multivariate* models. Again the *odds ratio* (with the *95-percent confidence interval*), the *Nagelkerke* R^2, the *-2 log likelihood* and the *constant* are shown. *Significant effects* are asterisked for different p-values. The table reveals that childhood stunting is the most important (highly) significant predictor of adolescent stunting. For instance, model 1 shows that the odds of being stunted in adolescence for children who were *moderately* stunted in childhood is 2.90 times the odds for children who were *not stunted* in childhood (reference category). The odds ratio of being stunted in adolescence for children who were *severely* stunted in childhood is even 8.10 times the odds for children who were *not stunted* in childhood (reference category). The significant effect of childhood underweight on the odds of being stunted in adolescence - which we observed in Table 5.18 - is lost when childhood underweight is considered together with childhood stunting into one model. Birth weight however remains significant, also when other predictors are added to the model (models 2 to 6). Model 2 shows that the odds of being stunted in adolescence for children who were born with a birth weight of 2000 grams or less is 2.26 times the odds for children with a higher weight at birth (reference category).

From models 3, 5 and 6 we learn that maternal height is not a significant predictor of the odds of adolescent stunting if childhood stunting, birth weight and sex of the child are taken into consideration. The (highly) significant effect of sex of the child, as earlier observed in Table 5.18, does prevail however and remains steady when the other significant predictors such as childhood stunting and birth weight are added to the analyses. In each of the models 4 to 6, the odds of being stunted in adolescence for girls is about 0.4 times the odds for boys (reference category), meaning that girls are less likely to be stunted in adolescents as compared to boys.

The *Nagelkerke* R^2 increases from 0.143 in model 1 to 0.224 in model 6. The latter figure indicates that 22.4 per cent of the variation in adolescent stunting is explained by the combined effect of the predictors included in this model, notably childhood stunting, birth weight and sex of the child.

Table 5.19 **Binary logistic multivariate regression models: odds ratios (with 95% CI) of adolescent stunting controlled for selected variables, Matlab 1988-2001**

	Odds ratio					
Predictors	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Childhood underweight				-	-	
Not underweight: > -2 SD *(ref)*	1.00	1.00	1.00			1.00
Moderately underweight: -3 to -2 SD	0.83 (0.47-1.47)	0.61 (0.26-1.46)	0.71 (0.29-1.73)			0.62 (0.25-1.54)
Severely underweight: < -3 SD	0.88 (0.40-1.92)	0.63 (0.21-1.91)	0.69 (0.23-2.08)			0.63 (0.20-1.98)
Childhood stunting						
Not stunted: > -2 SD *(ref)*	1.00	1.00	1.00	1.00	1.00	1.00
Moderately stunted: -3 to -2 SD	**2.90***(1.64-5.14)**	**4.35**(1.81-10.45)**	**3.98**(1.65-9.64)**	**2.96***(1.57-5.60)**	**2.97**(1.56-5.66)**	**4.12**(1.67-10.22)**
Severely stunted: < -3 SD	**8.10***(3.55-18.45)**	**10.20***(3.31-31.51)**	**8.58***(2.77-26.56)**	**8.36***(3.60-19.42)**	**7.58***(3.21-17.90)**	**10.81***(3.29-35.47)**
Birth weight	-					
> 2000 grams *(ref)*		1.00	1.00	1.00	1.00	1.00
<= 2000 grams		**2.26**(1.22-4.16)**	**2.07*(1.11-3.87)**	**2.33**(1.26-4.33)**	**2.17*(1.15-14.09)**	**2.19*(1.16-4.16)**
Maternal height	-	-		-		
145 cm or taller *(ref)*			1.00		1.00	1.00
Shorter than 145 cm			1.87 (0.71-4.91)		1.76 (0.66-4.64)	1.75 (0.66-4.63)
Sex of the child	-	-	-			
Male *(ref)*				1.00	1.00	1.00
Female				**0.44**(0.25-0.80)**	**0.43**(0.23-0.77)**	**0.41**(0.23-0.75)**
N	482	271	263	271	263	263
Nagelkerke R^2	0.143	0.181	0.184	0.210	0.219	0.224
-2 log likelihood	500.155	286.832	280.043	280.522	272.546	271.422
Constant (exp(B))	1.3919	0.889	0.820	1.148	1.119	1.260

**** P < 0.05; ** P<0.01; *** P < 0.001***

5.7 Conclusions and discussion

The central theme in this chapter is the nutritional status, indicated by anthropometry, of the adolescent study population in Matlab, Bangladesh, and its predisposition by nutritional status in early life, notably in early childhood and at birth. The analyses presented in this chapter were guided by hypotheses 4 through 9 (see section 3.2).

Adolescent nutritional status

In *hypothesis 4* it was stated that adolescents' nutritional status, as indicated by anthropometry, is poor. In line with this hypothesis, it appeared that irrespective of the indicator used, the adolescent population in our sample can be considered to be largely malnourished. For instance, 66 per cent of the adolescent boys and 46 per cent of the adolescent girls are *severely* (<-3 SD) underweight, whereas respectively 36 and 28 per cent of the adolescent boys and girls are *severely* (<-3 SD) stunted. The differences between boys and girls may be related to the combined effect of the difference in timing of the adolescent growth spurt, which generally sets in two years earlier in girls, and the possible difference in catch-up potential within the context of malnutrition. Malnourished adolescent boys aged 12 to 16 years may have a tendency to be 'just lean' and may catch up on their weight at a later stage in adolescence. However such an explanation is hypothetical in character: an unambiguous explanation for the relative overproportion of *severely* (<-3 SD) underweight boys cannot be provided as yet.

Weight and height in view of reproductive health

Our analysis indicates that *if* the 16-year-old girls would marry and get pregnant soon after that, almost 83 per cent would be at risk in terms of obstetric cut-off points for weight and almost a quarter, 23 per cent, would be at risk in terms of obstetric cut-off points for height.

Stunting status in adolescence and early childhood

The nutritional status of the adolescents in our sample is thus far from adequate, though comparable to that of their Indian peers. The large differences in sex- and age-specific weight and height scores with the (American) reference population is likely to be rooted earlier in life and is therefore also viewed in relation to nutritional status in early childhood. We hypothesised that malnutrition, as indicated by the level of stunting, is more prevalent among adolescents who were stunted in early childhood as compared to adolescents who were not stunted as an under-five (*hypothesis 5*). Both from the descriptive analyses as well as the binary logistic regression analyses, we learned that stunted under-fives are indeed highly likely to become stunted adolescents. For example, among boys who were *severely* (<-3 SD) stunted as an under-five, 71 percent remains *severely* (<-3 SD) stunted in adolescence. Also respectively 48 and 17 per cent of the *not stunted* (>-2 SD) under-five boys become *moderately* stunted (between -3 and -2 SD) and *severely* (<-3 SD) stunted in adolescence. However, 54 per cent of the girls who was *not stunted* as an under-five remains *not stunted* as an adolescent. The regression analyses revealed that, irrespective of sex, the odds of being stunted in adolescence for children who were *moderately* stunted in childhood is 1.64 times the odds for children who were *not stunted* in childhood, whereas the odds of being stunted in adolescence for children who were *severely* stunted in childhood is even 7.40 times the odds for children who were *not stunted* in childhood (reference category).

Catch-up potential: does age in early childhood and sex matter?

In previous studies it was found that the potential for catch up faltering growth (stunting) in childhood is limited after the age of two years, particularly when such children remain in poor environments (Gillespie and Flores 2000, p. 2). In line with this, we hypothesised that adolescents who were already stunted at the age of two years are more likely to remain stunted as compared to their *not stunted* same-aged counterparts in early childhood (*hypothesis 6*). In addition, the catch-up potential may also be different for boys and girls. Such a difference could be biological in nature, related to differences in growth velocity (height) whereby boys generally peak later than girls. In *hypothesis 9* we stated that girls are more likely to catch up early childhood growth faltering in adolescence than boys. The results showed that for boys as well as girls there is indeed some potential to catch up early life growth faltering (indicated by the level of stunting), but girls display a greater potential to improve their nutritional status, i.e. they are more likely to either maintain a *not stunted* status or to turn from a *moderately* or *severely* stunted under-five into a *not stunted* adolescent. However, we also found that girls who were stunted *around the age of two years* do *not* have a greater potential to catch up faltering growth than their male counterparts in adolescence. Among children who did *not* suffer faltering growth around the age of two years, girls are *less likely* than boys to become stunted in adolescence.

Does contemporary and early childhood nutritional status differ by sex?

In *hypothesis 8* we addressed the difference in nutritional status by sex. Given the prevailing inferior status of girls and women in many domains of life, among which include the nutritional domain (subsection 2.3.2), we hypothesised that both in *early childhood* and *adolescence*, girls are more likely to be malnourished as compared to their male counterparts. We observed that whereas on average *adolescent* girls are heavier compared to boys throughout the early and middle adolescent period, boys ultimately grow taller than girls, assuming that the nutritional status pattern (indicated by weight and height) pertaining to the ages 12 to 16 years prevails throughout the later stages of adolescence (ages 17 to 19 years). The turning point in height, i.e. when adolescent boys in our sample catch up with their female counterparts, is right after the age of 14 years. Contrary to what was hypothesised, we found that *adolescent* girls are less likely to be malnourished than boys. The binary logistic regression analyses revealed, for instance, that the odds of being stunted in adolescence for girls is about 0.4 times the odds for boys (reference category), meaning that girls are less likely to be stunted in adolescence than boys. In early childhood, however, girls are indeed relatively more often *severely* (<-3 SD) underweight and *severely* (<-3 SD) stunted than boys. However, if we consider two categories together - *moderate* and *severe* underweight respectively stunting - this difference is almost counterbalanced: the distributions for boys and girls being underweight respectively stunted in early childhood are than 71 against 69 per cent (underweight) and 64 against 67 per cent (stunted).

Adolescent stunting status and height of mother

Finally, we hypothesised that the likelihood of being stunted in adolescence is greater for adolescents whose mothers are stunted than for adolescents whose mothers are not stunted (*hypothesis 7*). The descriptive analyses showed that 49 per cent of the adolescents with a short mother (i.e. shorter than 145 cm) is *severely* (<-3 SD) stunted. This amounts to 29 per cent among adolescents with taller mothers. Also the correlation matrix showed a (highly) significant association between height of the mother and stunting status of the adolescent son or daughter. In addition, short mothers are more likely to have a child that is *severely* (<-3 SD) stunted in *early childhood* as compared to mothers who are not short. However, this apparent effect of maternal height on the stunting status of the (adolescent) child disappears completely in the multivariate analyses and may thus only have an indirect influence (for instance, *via* childhood stunting).

When taking all potential nutritional indicators together into consideration by means of binary logistic regression models, it appears that variation in stunting in adolescence is explained by the combined effect of the predictors included in this model, notably *childhood stunting*, *birth weight* and *sex* of the child. Programmes aimed at improving nutritional status of adolescence should therefore explicitly take the period of early childhood and the period of gestation into account. A central contention to studies undertaken by Barker and advocates is that babies with thrifty phenotypes, i.e. babies who are 'designed' to live in an environment that is chronically short on food, and who subsequently grow up in affluent environments "may operate sub-optimally" (Bateson 2001, p. 931). Given this notion, supplementing the diets of pregnant women whose children are likely to remain in a thrifty environment would be counter-productive (Bateson 2001, p. 933). Thus, rather than improving nutritional conditions in general, a specific approach may be needed whereby the key message could be to harmonise prenatal (in utero) nutritional conditions - or the 'maternal nutritional forecast' - with the postnatal nutritional environment. Obviously this recommendation should not be interpreted as an appeal to leave children in a poor nutritional environment (or to leave the poor as they are), but calls instead for a carefully monitored nutritional intervention programme whereby food supply is guaranteed for a longer period than just the pregnancy itself. A development that requires attention in this respect is the nutritional transition, which involves the co-existence of both malnutrition and overweight in a society. There is evidence that this transition is underway in India (Griffiths and Bentley 2001). In Bangladesh, however, only 1.1 per cent of the pre-school children in Bangladesh was overweight in 1996-1997 according to international reference of NCHS/WHO (de Onis and Blössner 2003, p. 524). In our study population overweight was virtually non-existent.

We should note however that the quality of the variable 'birth weight' is not optimal mainly due to the long period of recall. Comparing *recalled* birth weight with *observed* weight among the youngest children enrolled at baseline (i.e. those children who were 0 to 1 month old) revealed that the data on birth weight may be underestimated. On the basis of the aforementioned review of results the conclusion that adolescent nutritional status is to a large extent determined by sex and early life nutritional status, i.e. in early childhood and - possibly (see earlier comment about the need for caution) - at birth, seems to be sound.

6 Age at menarche in view of contemporary and early childhood nutritional anthropometry

6.1 Introduction

The *age at menarche* of adolescent girls is the central focus of study in this chapter. To a lesser extent, *age at spermarche* of adolescent boys is also examined. We study age at menarche in relation to (recalled) *age at menarche of the adolescent girl's mother, the girl's contemporary* and *early childhood nutritional anthropometry* and (recalled) *birth weight*. As elaborated in subsection 2.4.1, reproductive inheritance is among others reflected by associations with age at menarche between mothers and daughters (Gray 1993, p. 220). We also read in that subsection that one of the most important non-genetic determinants of menarche is nutritional status (Riley et al. 1993, p. 50). At first, timing of menarche was believed to be 'triggered' by a certain critical weight (Frisch and Revelle 1969; 1971). In later studies, other anthropometric indices such as adolescent height, MUAC and BMI were (also) positively associated with menarche (for instance, Delgado et al. 1985; Linhares et al. 1986; Maclure et al. 1991; Koprowski et al. 1999). More recently, there is growing support for the possibility that timing of menarche may be set *in utero* or early in life but may be modified by changes in body size and composition in childhood (Silva et al. 2003, pp. 405-412), a line of thinking which relates to the Barker hypothesis. The goal of this chapter is twofold. Working further on research questions 1 and 4 (as introduced in Chapter 1), and the corresponding hypotheses 1 to 3 (as formulated in Chapter 3) we first aim to describe:

- the observed age at which adolescent girls and boys from Matlab in our sample reach menarche and spermarche respectively.

  Moreover, as also indicated in Figure 6.1 which outlines the organisation of the research presented in this chapter and which follows Figure 2.4 on the determinants of menarche (see section 2.4.2), we study the following:

  - the relation between recalled age at menarche of *postmenarcheal* girls and that of their mothers (section 6.2);
  - the relation between respectively menarche status (all girls) and recalled age at menarche of *postmenarcheal* girls, and contemporary (adolescent) nutritional anthropometry (section 6.3);
  - the relation between menarche status (all girls) and recalled age at menarche of *postmenarcheal* girls, and early childhood anthropometry. In the present study early childhood anthropometry is indicated by an average figure based on a number of measurements (1 to 14) taken between the ages 0 to 5 years[54] (section 6.4).

Our second aim is to answer the following question:

- whether the probability of reaching menarche at a given age, and/or the expected age at menarche can be predicted on the basis of a given nutritional status profile in adolescence and/or early life, i.e. in early childhood and at birth (section 6.5). Expected timing of menarche and its nutritional determinants is studied by means

[54] At the time of the first measurement at baseline, the youngest child enrolled was 0 months and the eldest child was 47 months old.

of lifetable techniques and the Cox regression model. Here we account for censored cases, i.e. girls who were still premenarcheal at the time of interview.

Table 6.1 gives a description of the sample. Conclusions of this chapter are discussed in section 6.6.

Figure 6.1: Outline of analyses

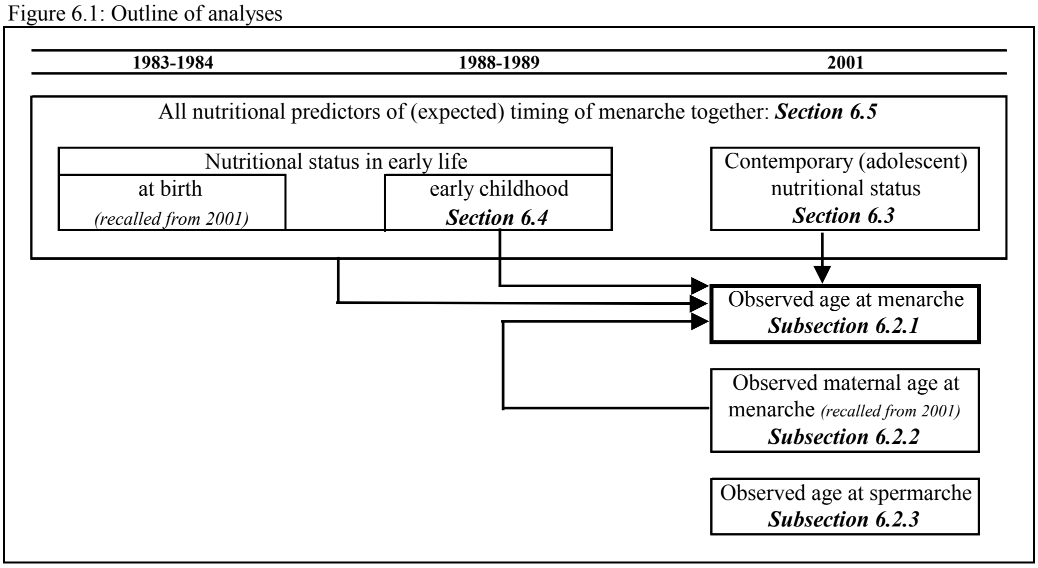


Table 6.1 Sample: main variables in analyses on reproductive health

Total number and percentage of adolescents at follow-up	562	**%**
Adolescents by sex		
adolescent boys	307	*55*
Adolescent boys by spermarche status		
postspermarcheal	40	*13*
prespermarcheal	220	*72*
not available	47	*15*
adolescent girls	255	*45*
Adolescent girls by menarche status		
postmenarcheal	97	*38*
premenarcheal	156	*61*
not available	2	*1*
Adolescent girls by maternal age at menarche	238	*93*
Adolescent girls by contemporary anthropometry	225	*88*
Adolescent girls by anthropometry in early childhood	251	*98*
Adolescent girls by recalled birth weight	136	*137*

6.2 Observed timing of menarche and spermarche

In this section we discuss three topics: menarche status of the adolescent girls in our sample, as well as the observed age at menarche among the *postmenarcheal* girls (subsection 6.2.1), the age at menarche among postmenarcheal girls in view of the age at menarche among their mothers (subsection 6.2.2), and the observed age at spermarche among the adolescent boys in our sample (subsection 6.2.3).

6.2.1 Observed age at menarche

Age at menarche in adolescent girls was determined by retrospective recall. Not all of the 12 to 16-year-old girls whom we interviewed had reached menarche or *mashik*. Figure 6.2 shows the distribution of postmenarcheal girls (*sabalikas*) in comparison with premenarcheal girls *(nabalikas*) by their age (at interview). The proportion of postmenarcheal girls (n=97) increases with age: from 7 among the 12-year-old girls to 81 per cent among the 16-year-old girls. A remarkable feature is the relatively high proportion of girls who had not yet reached menarche despite being 14, 15 or 16 years old. Among the 15 and 16-year-old girls respectively 41 and 19 per cent are still premenarcheal. The total number of *premenarcheal* girls in our sample amounted to 156, of whom 52 per cent was 14 years or older at the time of interview.

Figure 6.2: Distribution of adolescent girls by menarche status and age at interview, Matlab 2001 (%)

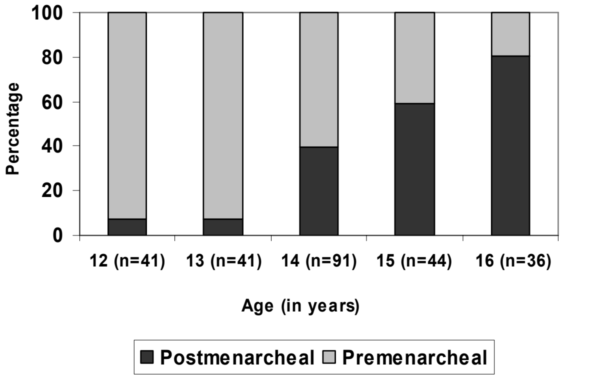
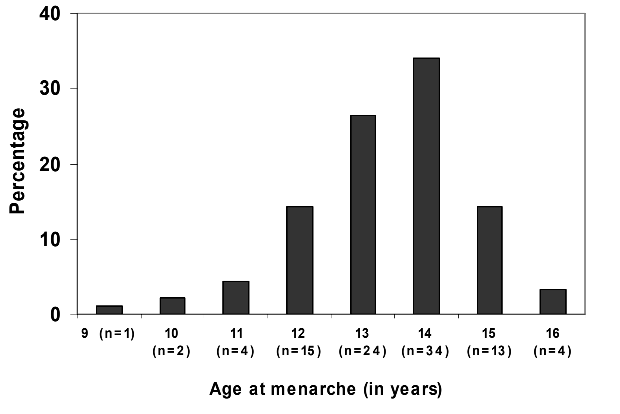


Figure 6.3 shows the distribution of *postmenarcheal* girls by observed (recalled) age at menarche. The youngest age at menarche observed in our study was 9 years; the highest age at menarche was 16 years (the highest age in our sample). Most (34 per cent) *postmenarcheal* girls reached menarche at the age of 14 years. From an international perspective (notably in comparison with contemporary Western countries), 14 years may be considered as a 'late' timing of menarche (see subsections 2.4.2 and 3.3.2).

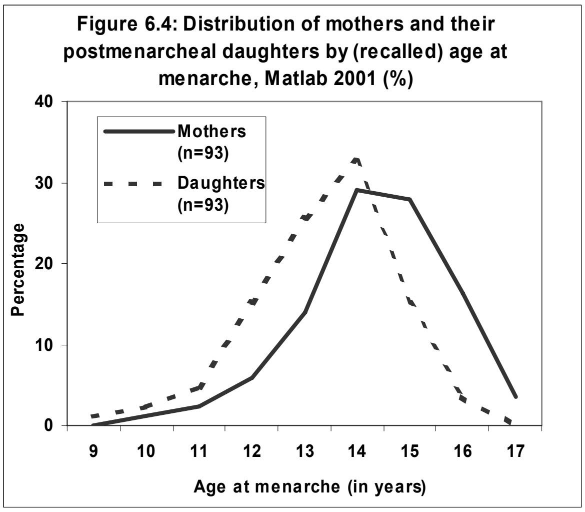
Figure 6.3: Distribution of postmenarcheal girls by observed age at menarche, Matlab 2001 (%)



6.2.2 Observed age at menarche of mothers and daughters

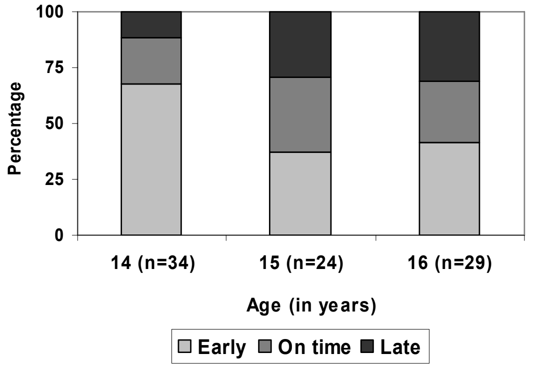
As elaborated in subsection 2.4.1, an ‘early’ or ‘late’ age at menarche may ‘run in the family’. The reproductive inheritance with regard to timing of menarche is among others grounded on the finding that age at menarche of mothers and their daughters is positively correlated (Gray 1993, p. 220). Our data on maternal age at menarche are based on the mothers’ recall in the follow-up survey in 2001 since this appeared to be the only means of data collection on this topic (see also Chapter 3). We were able to collect information from 238 mothers concerning (maternal) age at menarche. This figure corresponds to 93 per cent of adolescent girls in our sample (see also Table 6.1). The minimum and maximum (recalled) maternal age at menarche was 10 and 20 years, respectively.

Figure 6.4 shows the distribution of age at menarche among the group of mothers and their *postmenarcheal* daughters (n=93). Cross-cultural trend studies show that age at menarche generally declines over time at a pace of two months per decade (Becker 1993, p. 31). We observe that the *group of postmenarcheal* daughters reached menarche at a slightly younger age than their mothers. The question whether age at menarche generally declines over the two generations within our Bangladeshi population cannot yet be answered on the basis of this graph since we are not able to compare age at menarche between mothers and *all* daughters (thus including *premenarcheal* girls).



Irrespective of the *observed* age at menarche, timing of menarche of a *postmenarcheal* girl can also be regarded as ‘late’ when her age at menarche is higher than her mother’s age at menarche. As such, we analysed individual records, linking data on age at menarche of mothers and daughters. The distribution of *postmenarcheal* girls whose menarche was respectively ‘early’ (i.e. a girl reached menarche at a younger age than her mother did), ‘on time’ (i.e. a girl reached menarche at the same age as her mother did), or ‘late’ according to this definition is shown by their age (at interview) in Figure 6.5. As the values for the 12 and 13-year-old girls were based on only a few cases (2 and 3 cases respectively) they are not presented. It appeared that 78 per cent of the *postmenarcheal* girls reached menarche at the same age or earlier than their mother did. The other 22 per cent can thus be considered ‘late’ with regard to menarche. Menarche occurred ‘late’ among respectively 12, 29 and 31 per cent of the 14, 15 and 16-year-old *postmenarcheal* girls.

Figure 6.5: Distribution of postmenarcheal girls by timing of menarche (as compared to maternal age at menarche) and age at interview, Matlab 2001 (%)



In sum, although age at menarche may have declined over time when two generations of mothers and their *postmenarcheal* daughters are compared, analysis of individual level data does reveal a 'late' menarche among a subgroup of the adolescent girls: menarche is reached 'late' among 22 per cent of the *postmenarcheal* girls[55].

We also checked the extent to which findings from this subsection 6.2.2 are consistent with those from subsection 6.2.1, in which we examined timing in terms of age at menarche only. We looked explicitly at girls who are 'late' with reaching menarche according to age (i.e. being 14 years or older at menarche) and who are 'late' by comparison with maternal age at menarche. We found that among *postmenarcheal* girls who are 'late' with reaching menarche (according to the comparison with maternal age at menarche) 75 per cent corresponds with the group that has been defined as 'late' according to the aforementioned 'age-definition'. Later in this chapter, we study menarche status and its timing in relation to contemporary (section 6.3) and early childhood anthropometry (section 6.4). Particular attention will be paid to the anthropometry of those adolescent girls who reached menarche 'late' (according to age). However, before we do this, we discuss timing of sexual maturation among the adolescent boys in our sample.

6.2.3 Observed age at spermarche

In a study undertaken in rural Indonesia, self-reported age at (first) nocturnal ejaculation (spermarche) was shown to be valid, as well as culturally acceptable and appropriate milestone for maturity rating among adolescent boys (Soekarjo et al. 2003, pp. 27-39). Spermarche is an all but public event, and consequently shyness and

[55] Although premenarcheal girls have not experienced menarche yet, the absence of their menarche may point to a 'late' timing of menarche if their age (at interview) is higher than the age that their mothers started to menstruate. When making such a comparison between premenarcheal girls and their mothers, there are three options possible of which only the last two are relevant: at the time of interview a premenarcheal girl was either younger, as old, or older than her mother was when she reached menarche. The category 'younger' comprises girls of whom we are unable to say anything about the timing of their future menarche because this event cannot yet be expected given the age of menarche of their mothers. The proportion of premenarcheal girls who is currently older than their mother at the time the latter reached menarche amounts to 22 per cent.

ignorance surrounded the answers to our question whether this milestone was reached. Yet 40 boys in our sample (i.e. 15 per cent of all boys of whom information about this topic is available) replied in the affirmative to this question against 220 boys who replied in the negative. No information could be collected about this matter from 47 boys (see also Table 6.1). The youngest age at spermarche observed in our study was 12 years. At the age of 11 years all boys were thus *prespermarcheal*.

As noted in section 2.3, boys and girls have different rates of growth during adolescence (Bianculli 1985, pp. 49-53) and the spurt occurs two years later in boys than in girls, but it is greater and lasts longer in boys (Lachance 1995, p. 7; WHO 2003, p. 10). Following this difference, girls may also be more advanced, by age, in terms of reproductive development than boys. This assumption corroborates results presented in Table 6.2 which shows the distribution of adolescent girls and boys who have already reached respectively menarche and spermarche (by age at interview).

Table 6.2 Distribution of postmenarcheal girls and postspermarcheal boys by age at interview, Matlab 2001 (cumulative %)

Age (in years)	Postmenarcheal girls (%)	n	Postspermarcheal boys (%)	n
12	7	41	3	36
13	7	41	7	68
14	40	91	4	67
15	59	44	30	66
16	81	36	48	23
n*		253		260

** Excluding 2 girls and 47 boys of whom no information could be collected (see Table 6.1)*

Particularly at the ages of 14, 15 and 16 years the difference between the sexes becomes pronounced. Among girls aged 14 years, for instance, 40 per cent has reached menarche, whereas among their similar-aged male counterparts 4 per cent has experienced spermarche. It should be recalled, as stipulated in subsection 2.4.2, that menarche and spermarche are events with different socio-cultural connotations. The percentage of boys having reached spermarche may be underreported because boys possibly did - even more than girls with regard to menarche - not feel comfortable talking about this transition. Because we do not have insight into the extent and role of these social factors on the possible underreporting, we will not consider data on timing of spermarche further in the analyses on nutritional anthropometry.

6.3 Contemporary nutritional anthropometry and menarche

In this section we analyse menarche status and timing in relation to contemporary, i.e. adolescent, nutritional anthropometry. Contemporary nutritional anthropometry was measured in the follow-up survey in 2001 and not necessarily *before* the reaching of menarche. Thus, weight and height of *postmenarcheal* girls were measured *after* the reaching of menarche whereas - given their premenarcheal status - these measurements were taken *before* the occurrence of this event among *premenarcheal* girls. Strictly speaking, we can therefore not regard contemporary weight and height (and hence weight-for-age, height-for-age and Body Mass Index[56]) as 'determinants' of timing of menarche in postmenarcheal girls. Given the absence of information about *postmenarcheal* girls' anthropometry *before* menarche, we *assume* that contemporary weight and height, i.e. as measured at the follow-up interview, also reflect their anthropometry before menarche. It is worth noting in this respect that among 31 per cent of the *postmenarcheal* girls, menarche occurred recently, i.e. within the 12 months proceeding the survey.

From Chapter 5 we saw that the adolescent girls among our study population are largely malnourished: 46 per cent is *severely* (<-3 SD) underweight (reflecting weight-for-age), and 28 per cent is *severely* (<-3 SD) stunted (reflecting height-for-age). The analyses presented in this section are based on the assumption that the expected timing of menarche of a girl is related to her current nutritional status, as indexed by anthropometry. First, we review weight and height among the adolescent girls in our sample according to their menarche status (subsection 6.3.1). After that, we analyse timing of menarche in view of contemporary level of underweight, stunting and BMI (subsection 6.3.2). The review of these anthropometric indices is based on a *comparison* with an adequately nourished population of girls of the same age, i.e. the CDC *reference population* of 2000, US NCHS (see section 3.3.2).

6.3.1 Adolescent weight and height in relation to menarche status

Table 6.3 shows anthropometry, indexed by weight and height, of adolescent girls by menarche status and age (at interview), as measured at the follow-up interview in 2001.

Table 6.3 Antropometry of adolescent girls by menarche status and age at interview, Matlab 2001

Menarche status	Age at interview (in years)	Mean weight (kg)	Mean height (cm)
Post-menarcheal (n=87)	12 (n=3)	34.5	144.2
	13 (n=3)	43.7	152.0
	14 (n=33)	37.7	149.8
	15 (n=24)	39.0	147.9
	16 (n=24)	40.7	150.5
	Group mean	39.0	149.4
Pre-menarcheal (n=138)	12 (n=35)	27.0	135.9
	13 (n=32)	27.8	137.3
	14 (n=51)	30.6	140.8
	15 (n=14)	33.3	144.2
	16 (n=6)	32.8	144.1
	Group mean	29.4	139.2

56 BMI is calculated as weight/height^2 (see also subsection 3.3.2).

It can be seen that mean weight and height are higher among *postmenarcheal* girls as compared to *premenarcheal* girls. Age (at interview) does not seem to confound this observation: at every age the mean values are higher for *postmenarcheal* girls as compared to their *premenarcheal* peers, suggesting a positive association between nutritional anthropometry and the pace of the reproductive development process.

When we compare these mean values with results from other studies (as reviewed in subsection 2.4.1) on adolescent populations, our data seem to suggest that relative to their menarche status the girls in our sample are indeed relatively light and small. A mean weight at menarche of 48 kg, as found by Kurdzielewicz et al. (1999) for instance, and a corresponding height of 159.2 cm and BMI of 18.9 are far above the average values in our postmenarcheal Bangladeshi population. Koziel and Jankowska (2002, p. 269) found the average weight and height among 1060 premenarcheal and postmenarcheal 14-year-old Polish girls to be respectively 51.9 kg and 161.1 cm. Among our 14-year-old Bangladeshi girls (n=225) the average weight and height are respectively 33.1 kg and 144.1 cm (not shown).

Rao et al. (1998) found a mean weight of 38.0 kg at menarche for Indian girls, irrespective of age at this event. This is slightly lower than what we found (39.0 kg) among the population of *postmenarcheal* girls in our sample (all girls, irrespective of age). However, it should be taken into account that our anthropometric measurements were not collected at the moment that menarche occurred. As noted before, among 31 per cent of the postmenarcheal girls menarche commenced within the year proceeding the survey, whereas the other postmenarcheal girls reached menarche on average 2.6 years ago. Considering the fact that the Bangladeshi postmenarcheal girls are likely to have gained weight since menarche, the aforementioned weight of 39.0 kg can even be considered as relatively low. In order to circumvent the aforementioned drawback, we repeated the analyses whereby we subselected *postmenarcheal* girls whose age at menarche is equal to their age (at interview) as these girls have reached menarche recently, i.e. within the past year. Though we were left with a few cases (n=27), we computed a mean weight of 37.4 kg, a figure that matches the one reported by Rao et al. (1998).

The above problem brings us to another approach to the study on timing of menarche, i.e. calculating whether a girl's weight is below or above the mean or 'critical' weight of the population she belongs to. The 'critical weight' is believed to be the weight that has to be reached for menarche (Frisch and Revelle 1969; 1971) and reflects the average weight at menarche within the population. Similarly a 'critical height' could be formulated. Obviously a critical weight and height can be calculated for *postmenarcheal* girls only. We rely on the aforementioned mean weight and height of those girls whose age (at interview) equals their age at menarche (n=27). In this way we obtain a more 'accurate' critical weight and height, namely 37.4 kg and 148.0 cm respectively. Accordingly, we looked at whether the girls' weight and height are above or below these cut-off points (i.e. the group mean of the population to which they belong to) by menarche status (Table 6.4).

Table 6.4 Distribution of adolescent girls whose weight and height are above or below the critical means by menarche status, Matlab 2001 (%)

Menarche status	Critical weight (37.4 kg)		Critical height (148.0 cm)	
	Above (%)	Below (%)	Above (%)	Below (%)
Postmenarcheal	87	21	80	22
Premenarcheal	13	79	20	78
n	100 (n=60)	100 (n=165)	100 (n=64)	100 (n=161)

From Table 6.4 we see that among the girls whose weight and height are above the critical cut-off points, the majority (87 and 80 per cent) are *postmenarcheal*. Within the group of girls whose weight and height are below the critical cut-off points, the majority (79 and 78 per cent) are *premenarcheal*. However, several of these premenarcheal girls are still young (i.e. 12 or 13 years). When we consider only *premenarcheal* girls of 14 years or older (not shown) we find that among the group of girls whose weight and height is *above* the critical cut-off point, 13 and 18 per cent are still *premenarcheal*. Possibly, the aforementioned indicated critical weight and height approach the ones that would be relevant for this particular study population, but our analysis is based on too few cases to assess such values properly.

6.3.2 Adolescent underweight, stunting, BMI and menarche status

After having reviewed weight and height among the adolescent girls in our sample according to their menarche status, we now analyse timing of menarche in view of contemporary level of underweight (weight-for-age), stunting (height-for-age) and BMI as compared to an adequately nourished population of girls of the same age, i.e. the CDC *reference population* of 2000, US NCHS (see section 3.3.2).

In Figures 6.6 and 6.7 respectively, the distribution of adolescent girls according to menarche status (*postmenarcheal* versus *premenarcheal*) is expressed by level of contemporary underweight and stunting.

Figure 6.6: Distribution of adolescent girls by level of underweight (weight-for-age) and menarche status, Matlab 2001 (%)

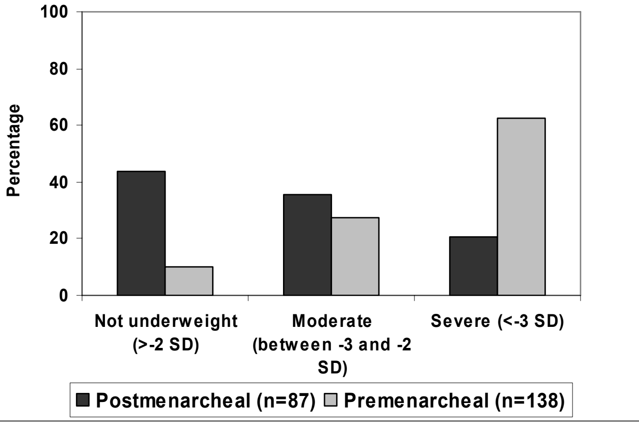


Figure 6.7: Distribution of adolescent girls by level of stunting (height-for-age) and menarche status, Matlab 2001 (%)

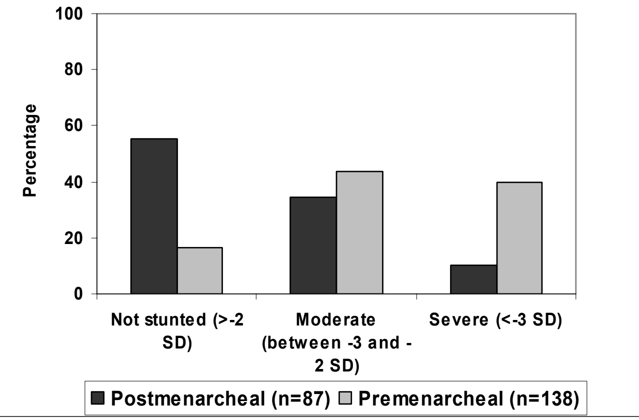


Figure 6.6 reveals that the largest proportion of girls who are *not underweight* (>-2 SD) is to be found among postmenarcheal girls (44 per cent), whereas the highest proportion of *severely* (<-3 SD) underweight is to be found among premenarcheal girls (62 per cent). With regard to stunting (Figure 6.7), we see that premenarcheal girls are considerably more often *moderately* (between -3 and -2 SD) and *severely* (<-3 SD) stunted as compared to their postmenarcheal peers (respectively 44 and 40 per cent among premenarcheal girls versus 35 and 10 per cent among postmenarcheal girls). Figures 6.6 and 6.7 are in line with previously described observations in section 6.3.1 that suggest that the nutritional status, as indexed by weight and height, of the postmenarcheal girls in our sample is more 'adequate' as compared to that of their premenarcheal counterparts.

As we learned from Chapter 5 (section 5.3) underweight and stunting profiles among adolescent girls differ by age. Referring to Table 5.5 for instance, the proportion of *not underweight* (>-2 SD) girls increased by age from 18 per cent among 12-year-olds to 27 per cent among 16-year-olds. Table 6.5 shows the distribution of girls by level of contemporary underweight, menarche status and age (at interview). For postmenarcheal girls we excluded the data pertaining to the ages 12 and 13 years because they represent too few cases (respectively 3 for each age). In addition, we excluded the data pertaining to premenarcheal girls who are currently younger than 14 years because - given their young age - we cannot say anything about the absence of menarche in relation to their nutritional status.

Table 6.5 shows a considerable difference, at every age, in the extent of underweight between postmenarcheal and premenarcheal girls. The proportion of *severe* (<-3 SD) underweight amounts to 67 per cent among 14-year-old premenarcheal girls, compared to 15 per cent for same-aged postmenarcheal girls.

Table 6.5 **Distribution of adolescent girls by level of contemporary underweight* (weight-for-age), menarche status and age at interview, Matlab 2001 (%)**

Menarche status	Age at interview (in years)	Level of underweight > -2 SD not underweight	-3 to -2 SD moderate	< -3 SD severe	Total (n)
Postmenarcheal	14	46	39	15	100 (n=33)
	15	42	38	20	100 (n=24)
	16	33	33	34	100 (n=24)
Premenarcheal	14	12	22	67	100 (n=51)
	15	0	21	79	100 (n=14)
	16	0	17	83	100 (n=6)

** Using the CDC reference population of 2000 (US NCHS)*

In Table 6.6 we consider the level of stunting by menarche status and age (at interview). We find the proportions *not stunted* (>-2 SD) to be higher at every age among postmenarcheal as compared to premenarcheal girls. Taking 14-year-old girls as an example, 58 per cent of the postmenarcheal girls is *not stunted* against 10 per cent of their premenarcheal peers.

Table 6.6 **Distribution of adolescent girls by level of contemporary stunting* (height-for-age), menarche status and age at interview, Matlab 2001 (%)**

Menarche status	Age at interview (in years)	Level of stunting > -2 SD not stunted	-3 to -2 SD moderate	< -3 SD severe	Total (n)
Postmenarcheal	14	58	39	3	100 (n=33)
	15	38	41	21	100 (n=24)
	16	58	29	13	100 (n=24)
Premenarcheal	14	10	41	49	100 (n=51)
	15	29	42	29	100 (n=14)
	16	17	33	50	100 (n=6)

** Using the CDC reference population of 2000 (US NCHS)*

In sum, we thus find a similar pattern: at every age higher levels of contemporary underweight and stunting are found among premenarcheal girls as opposed to their postmenarcheal peers. Particularly for premenarcheal girls, the likelihood of underweight increases by age. Given that the differences in nutritional anthropometry by menarche status are more pronounced when contemporary weight-for-age is considered than when the data are broken down by height-for-age, adolescent weight may be a more important determinant of menarche than adolescent height.

In respectively Figures 6.8 and 6.9 the distribution of postmenarcheal and premenarcheal is presented by level of Chronic Energy Deficiency (CED) according to BMI, expressed in Z-scores (see section 3.3.2), and age (at interview) in years.

Figure 6.8: Distribution of postmenarcheal girls by level of CED according to BMI Z-scores and age at interview, Matlab 2001 (%)

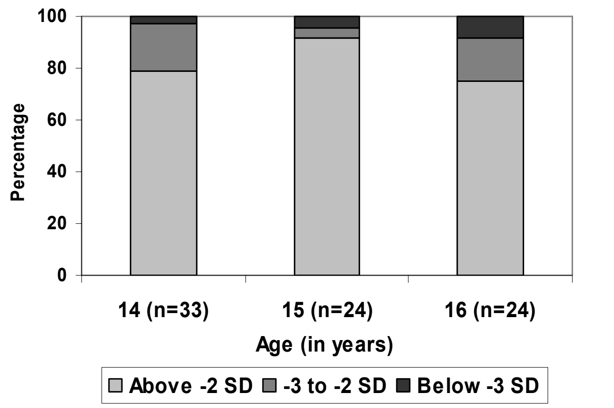
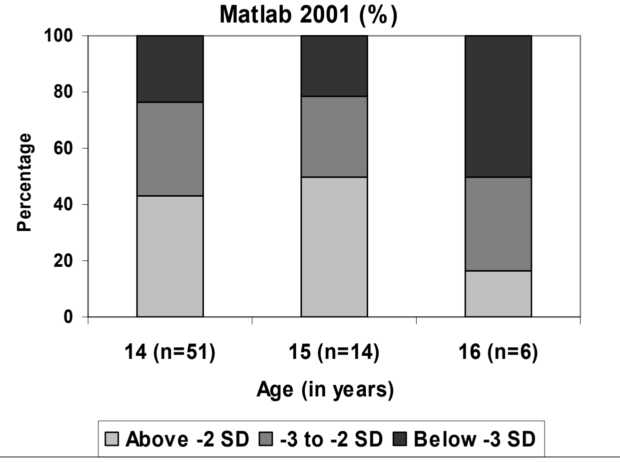


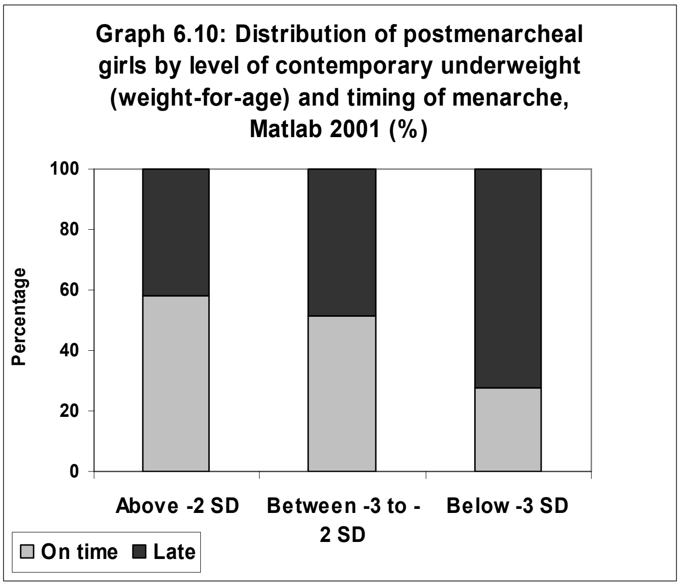
Figure 6.9: Distribution of premenarcheal girls by level of CED according to BMI Z-scores and age at interview, Matlab 2001 (%)

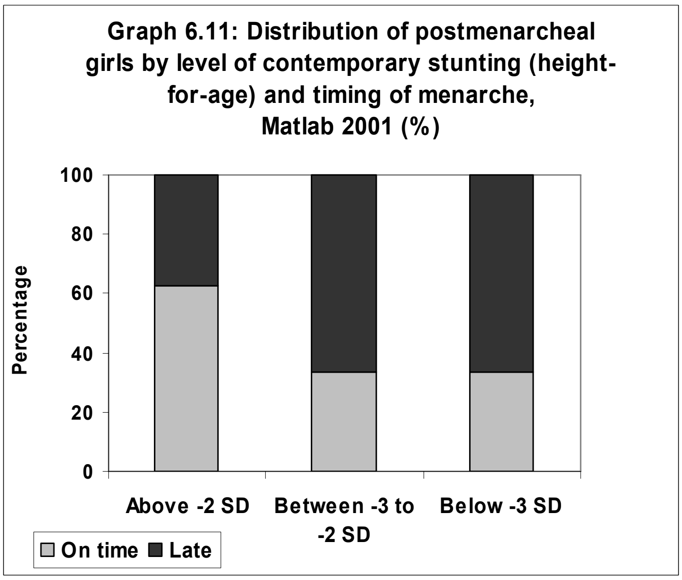


Nutritional status as represented by level of Chronic Energy Deficiency (CED) according to BMI Z-scores is more 'adequate' for postmenarcheal girls as compared to premenarcheal girls. At the age of 14 years for instance, the proportion of girls with *severely* (<-3 SD) CED is 3 per cent among postmenarcheal girls but 24 per cent among premenarcheal girls. These results are in line with the findings on weight, height, underweight and stunting, which we discussed before. In addition, level of CED seems to present a more 'positive' picture of nutritional status - i.e. lower percentages *severely* (<-3 SD) malnourished and higher percentages of no malnutrition (>-2 SD) - as compared to for instance an indicator such as underweight. This was observed in Chapter 5 as well.

'Late' menarche

Having analysed the nutritional anthropometry of adolescent girls by menarche status and age, the key question that needs to be answered is whether girls who have been identified as being 'late' with reaching sexual maturity according to age at menarche (as described in subsection 6.3.1) have a less adequate nutritional status in terms of level of underweight and stunting as compared to their counterparts who are 'on time'. Figures 6.10 and 6.11 show the distribution of *postmenarcheal* girls by level of contemporary underweight and stunting respectively, and timing of menarche. A 'late' menarche is defined as a menarche reached at an age of 14 years or older.





The two graphs show that the proportion of *postmenarcheal* girls whose menarche began 'late' is disproportionately larger within the malnourished group, both in terms of underweight as well as stunting. An example may illustrate this: of the girls who are *severely* (<-3 SD) underweight in adolescence, 72 per cent experienced menarche 'late', whereas the corresponding figure in the group of girls who were *not underweight* (>-2 SD) in adolescence is 41 per cent. In addition, menarche occurred 'late' in two-thirds (67 per cent) of the *postmenarcheal* girls who are *moderately* (between -3 and -2 SD) or *severely* (<-3 SD) stunted in adolescence.

As observed in Chapter 5, there is a strong correlation of these two contemporary nutritional indicators (adolescent underweight and stunting) and indicators of nutritional status in early childhood. The apparent association between adolescent nutritional anthropometry and timing of menarche may thus be rooted in early childhood, or possibly even at birth. Associations between timing of menarche and nutritional anthropometry in early childhood are discussed next.

6.4 Nutritional anthropometry in early childhood and menarche

This section studies whether there is evidence that the timing of menarche is predisposed by early childhood nutritional status. The latter is indicated by level of *childhood underweight* and *stunting* (subsection 6.4.1). We calculated these indicators on the basis of weight and height data collected by Baqui in 1988-1989 (see section 3.6), which we compared with data pertaining to an adequately nourished population of girls of the same age, i.e. the CDC/WHO reference population of 1978, US NCHS (see subsection 3.3.2). The results only shed a preliminary indication of the possible early childhood origins of timing of menarche. Strengths and directions of correlation between menarche and the respective indicators of contemporary and early childhood nutritional status are discussed thereafter (subsection 6.4.2).

6.4.1 Childhood underweight and stunting in view of menarche

Table 6.7 shows the distribution of adolescent girls by level of childhood underweight (weight-for-age), menarche status and age (at interview) (again only the ages 14, 15 and 16 years are considered).

Table 6.7 Distribution of adolescent girls by level of childhood underweight* (weight-for-age), menarche status and age at interview, Matlab 1988-2001 (%)

Menarche status	Age at interview (in years)	Level of underweight >-2 SD not underweight	-3 to -2 SD moderate	<-3 SD severe	Total (n)
Postmenarcheal	14	31	47	22	100 (n=36)
	15	19	46	35	100 (n=26)
	16	20	35	45	100 (n=29)
Premenarcheal	14	19	22	59	100 (n=54)
	15	6	38	56	100 (n=18)
	16	14	15	71	100 (n=7)

* *Using the CDC/ WHO reference population of 1978 (US NCHS)*

Table 6.7, reveals that premenarcheal girls were more likely to be underweight as an under-five as compared to their postmenarcheal peers of the same age. Again taking age 14 as an illustration (most girls in both groups are 14 years old), we see that among postmenarcheal girls 47 and 22 per cent were respectively *moderately* (between -3 and -2 SD) and *severely* (<-3 SD) underweight in early childhood, whereas it is respectively 22 and 59 per cent among premenarcheal girls.

Whereas the data in Table 6.7 are presented by age (at interview) of the adolescent girls, Figure 6.12 shows the distribution of *postmenarcheal* girls by level of childhood underweight and timing of menarche. Again, an age at menarche of 14 years or older is considered as 'late' and an age at menarche below 14 years is considered 'on time'. Level of underweight does indeed seem to be associated with the likelihood of being 'late' with the reaching of menarche in adolescence. Girls who were *severely* (<-3 SD) underweight as an under-five child appear to be most likely to be late with the reaching of menarche.

Figure 6.12: Distribution of postmenarcheal girls by level of childhood underweight (weight-for-age) and timing of menarche, Matlab 1988-2001 (%)

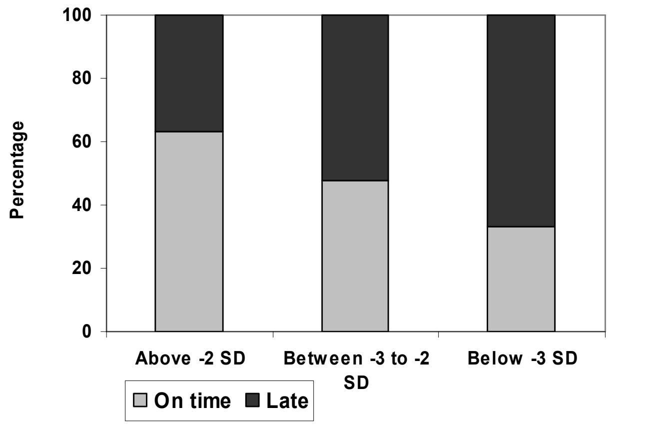


Table 6.8 presents the distributions of adolescent girls by level of childhood stunting (height-for-age), menarche status and age (at interview) (again only the ages 14, 15 and 16 years are considered).

Table 6.8 Distribution of adolescent girls by level of childhood stunting* (height-for-age), menarche status and age at interview, Matlab 1988-2001 (%)

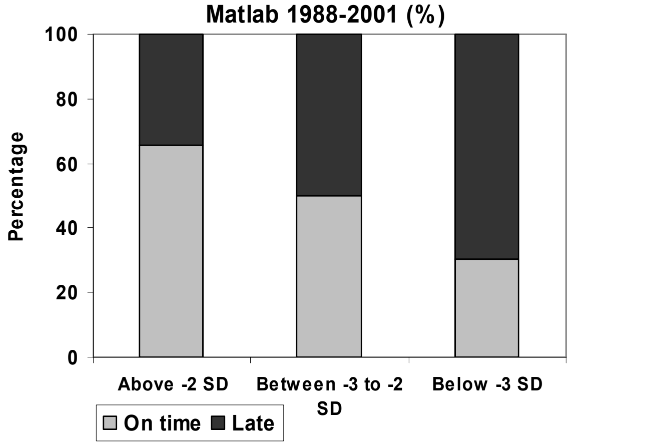
Menarche status	Age at interview (in years)	Level of stunting: >-2 SD not stunted	-3 to -2 SD moderate	<-3 SD severe	Total (n)
Postmenarcheal	14	36	50	14	100 (n=36)
	15	27	27	46	100 (n=26)
	16	10	24	66	100 (n=29)
Premenarcheal	14	11	37	52	100 (n=54)
	15	17	22	61	100 (n=18)
	16	0	29	71	100 (n=7)

* *Using the CDC/ WHO reference population of 1978 (US NCHS)*

At every age, the relative distribution over the respective levels of *childhood stunting* is even more pronounced by menarche status as compared to the figures on *childhood underweight*. Whereas 52 per cent of the 14-year-old premenarcheal girls was *severely* (<-3 SD) stunted as an under-five, this figure was 14 per cent among same-aged postmenarcheal girls.

Figure 6.13 shows the distribution of *postmenarcheal* girls by level of childhood stunting and timing of menarche. The figure affirms the strong association between childhood stunting and menarche. The higher the level of stunting in early childhood, the greater the likelihood that a girl experiences menarche ‘late’. Yet, among girls who were *not stunted* (>-2 SD) in childhood, 35 per cent is ‘late’ with the onset of menarche. Further associations between early childhood nutritional anthropometry, as well as recalled birth weight, and timing of menarche are studied in section 6.5, whereby contemporary, thus nutritional anthropometry in adolescence, will also be taken into account. However, first we discuss strengths and directions of correlation between menarche (status and timing) and the respective indicators of contemporary and early childhood nutritional status in subsection 6.4.2.

Figure 6.13: Distribution of postmenarcheal girls by level of childhood stunting (height-for-age) and timing of menarche, Matlab 1988-2001 (%)



6.4.2 Strengths and directions of correlation

In this subsection we explore the strengths and directions of correlation between the dependent and independent variables. Table 6.9 shows the (bivariate) correlation matrices of respectively menarche status (premenarcheal versus postmenarcheal) of *all girls* in our sample and timing of menarche (younger than 14 years versus 14 years or older) of *postmenarcheal* girls in our sample with the selected predictors (in order of appearance in the previous sections)[57]. In general, three correlation coefficients can be distinguished: *Pearson’s*, *Spearman’s rho* and *Kendall’s tau-b* coefficients (see also subsection 5.6.1). Since the two dependent variables, menarche status and timing of menarche, are both dichotomous variables we used *Kendall’s tau-b* coefficient (a

[57] Strengths and directions of correlation between the respective predictor variables - the extent of multicollinearity between different nutritional status indicators - have been discussed in chapter 5 (subsection 5.6.1).

measure of association for nominal data) to indicate their strengths and directions of correlation with potential predictors. A p-value less than 0.01 and 0.05 indicates a significant statistical correlation between two variables considered (indicated in the table by asterisks). Table 6.9 includes the following variables:

- menarche status - measured at time of survey, thus at different ages - of all girls (categorical, dichotomous i.e. 0 = premenarcheal; 1 = postmenarcheal);
- timing of menarche of postmenarcheal girls (categorical, dichotomous i.e. 0 = younger than 14 years; 1 = 14 years or older);
- maternal age at menarche (continuous);
- adolescent weight and height (irrespective of age) (continuous);
- adolescent underweight and stunting (categorical, 1 = not underweight respectively not stunted or >-2 SD from the median; 2 = moderately underweight respectively stunted or between -3 and -2 SD from the median; 3 = severely underweight respectively stunted or <-3 SD from the median);
- adolescent Chronic Energy Deficiency according to BMI Z-scores (categorical, 1 = not CED >-2 SD from the median; 2 = moderately CED or between -3 and -2 SD from the median; 3 = severely CED or <-3 SD from the median);
- childhood underweight and stunting (categorical, 1 = not underweight respectively not stunted or >-2 SD from the median; 2 = moderately underweight respectively stunted or between -3 and -2 SD from the median; 3 = severely underweight respectively stunted or <-3 SD from the median); and
- recalled birth weight[58] (categorical, dichotomous i.e. 0 = 2000 grams or less; 1 = more than 2000 grams).

Table 6.9 Strenghts and directions of correlation between dependent variables and selected predictors, Matlab 1988-2001

	Selected predictors								
Dependent variables	Maternal age at menarche	Adolescent weight	Adolescent height	Adolescent underweight	Adolescent stunting	Adolescent BMI	Childhood underweight	Childhood stunting	Recalled birth weight
Menarche status (all girls)	-0.050	**0.572****	**0.506****	**-0.431****	**-0.405****	**-0.345****	-0.015	0.052	**0.292****
n	238	225	225	225	225	225	253	253	137
Timing of menarche (postmenarcheal girls)	0.058	-0.101	-0.145	0.193	**0.271****	0.061	**0.214***	**0.271****	-0.082
n	93	87	87	87	87	87	97	97	50

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

From Table 6.9 we see that among the girls in our sample *menarche status* (premenarcheal versus postmenarcheal) is significantly correlated with:

- adolescent (contemporary) weight and height (positive), meaning that the higher a girl's weight and height in adolescence are, the more likely she is postmenarcheal;

[58] All girls of whom recalled birth weight was known are included in the analyses (n=137). The causes of low birth weight may however differ: 22 girls had a low birth weight in conjunction with an early (recalled) timing of the birth (so they are probably light because of a young gestational age).

- adolescent (contemporary) underweight, stunting and CED according to BMI Z-scores (negative), meaning that the more adequate a girl's nutritional status in adolescence is according to these three anthropometric indices, the more likely it is that she is postmenarcheal; and
- a girl's recalled birth weight (positive), meaning that a birth weight of more than 2000 grams is correlated with a greater likelihood that an adolescent girl is postmenarcheal.

Moreover, we observe from Table 6.9 that among *postmenarcheal* girls in our sample, *timing of menarche* (on time versus late) is significantly correlated with:

- adolescent stunting (positive), meaning that a postmenarcheal girl who is stunted in adolescence is more likely to have reached menarche at an age of 14 years or older (late menarche); and
- childhood underweight and stunting (positive), meaning that a postmenarcheal girl who was underweight or stunted in early childhood is more likely to have reached menarche at an age of 14 years or older (late menarche).

The aforementioned correlations between menarche status and adolescent anthropometry are in line with the results as described in section 6.3, although we also expected - on the basis of Tables 6.7 and 6.8 (see subsection 6.4.1) - a correlation between menarche status and childhood underweight and stunting. The correlation between timing of menarche and adolescent stunting, respectively childhood underweight and stunting, is however corroborated by the results described in sections 6.3 and 6.4. The effect of maternal age at menarche appeared not to be significantly correlated to any of the two dependent variables.

We did not find a significant correlation between *timing of menarche* and birth weight. Our results are here in line with findings of Lumey and Stein (1997, p. 1964) who also did *not* find a detectable effect of in utero famine exposure on age at menarche. Our data do *not* confirm the counterintuitive results of for instance Koziel and Jankowska (2002, p. 269) who found that girls born with a low birth weight for gestational age are more likely to have experienced menarche by the age of 14 years as compared to their peers with a birth weight appropriate to gestational age. However, as outlined in section 2.4.1, the relationship between in utero nutritional conditions - reflected by birth weight - and timing of menarche remains ambiguous. Moreover, our findings should be seen in light of the probably less optimal quality of the data: the data on birth weight are recalled by the adolescents' mothers 12 to 16 years after the birth. In addition, as indicated in footnote 58, some girls in our sample are born premature, which can be associated with low birth weight. Other girls may have a low birth weight because of intrauterine growth retardation. Possibly, prematurity and intrauterine growth retardation, though both resulting in low weight at birth, may have a different impact on the timing of menarche.

Next, we will further explore the *expected* timing of menarche and its contemporary and early childhood nutritional predictors by means of lifetable analyses, whereby we also take into account premenarcheal girls.

6.5 Expected timing of menarche and its nutritional predictors

In this section we aim to answer the question of the effect of nutritional status at different moments in life on the *expected* age at menarche. To this end, timing of menarche is expressed in two ways. The first is the probability of menarche at consecutive ages, which is reflected by the empirical survival function. The second is a summary measure of the survival function, namely the median age at menarche. Both measures are obtained using the *lifetable* for the sample population stratified by nutritional anthropometry. The *lifetable* accounts for censoring. An observation is censored when the respondent has not experienced the event of interest - in this study the event is menarche - by the end of the study. Among our study population, 61 per cent (see Table 6.1, section 6.1) of the 12 to 16-year-old girls is premenarcheal (censored cases).

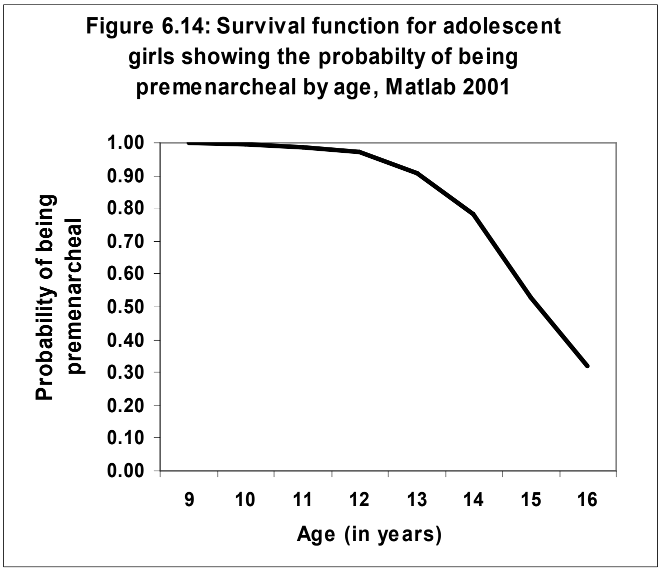
The outline of this section is as follows. First, the median age at transition of menarcheal status is calculated using the *lifetable* (subsection 6.5.1). Thereafter, the rate of reaching menarche is estimated for each age and each nutritional status indicator separately (subsection 6.5.2). This rate is the potential to experience menarche at a given age x provided that the girl has reached age x and is *premenarcheal*. Another approach is the *Cox regression model* or proportional hazard model, which estimates an 'average' relative risk for all ages (subsection 6.5.3). It assumes that the rates of the onset of menarche for girls of different nutritional status are proportional and the proportionality factor does not depend on age. The *Cox* model, like the *lifetable* and other techniques of survival analysis, makes use of the contribution of censored cases.

6.5.1 Age at transition of menarcheal status

Menarche is a transition from being *premenarcheal* to becoming *postmenarcheal*. Hence, menarche can be studied using so-called transition models, i.e. statistical and demographic models of the age at a transition in the lifecourse. The probability of experiencing this transition from premenarcheal to postmenarcheal increases with age. As described in section 6.2, the youngest age at menarche observed in our study was 9 years. At the age of 8 years all girls in our sample were thus premenarcheal. The highest age at menarche recalled is 16 years (the highest age included in our study).

As shown in Figure 6.2, the proportion of postmenarcheal girls in our sample increases by age. Given this pattern, data on age at menarche can also be expressed in terms of a *lifetable,* whereby the survival function is determined by the probability of reaching menarche at age x. The *lifetable* accounts for censoring, which in this research refers to being premenarcheal on reaching the survey date. Figure 6.14 reflects the survival function, which displays for each age between 9 and 16 years the probability of being *premenarcheal*. It clearly shows that the probability that a girl is premenarcheal decreases by age. The probability that a *premenarcheal* girl of exact age x (in years) becomes *postmenarcheal* before reaching age x+1 is calculated as:

((probability density at exact age x)/(cumulative proportion surviving at exact age x)) * 100



Accordingly, the probability of a *premenarcheal* girl of exactly 11 years becoming post-menarcheal before reaching age 12 is less than 2 per cent (*lifetable* is not shown). The probability of a *premenarcheal* girl of exactly 13 years becoming postmenarcheal before her 14th birthday is 14 per cent. Similarly, the probability of a *premenarcheal* girl of exactly 14 years becoming postmenarcheal before her 15th birthday is 33 per cent and the probability of a *premenarcheal* girl of exactly 15 years becoming postmenarcheal before the 16th birthday is 39 per cent. The median survival time, i.e. the median age at which the *premenarcheal* girls in our sample become *postmenarcheal*, is 15.1 years. This figure cannot be compared with results generated in other studies which we reviewed in subsection 2.4.2 (for instance Chowdhury et al. 1977; Riley 1994) because they present the *average* age at menarche of an adolescent population, without taking into account censoring, i.e. they thus leave out premenarcheal girls as a result of which the average figures are likely to be too low (median versus average).

6.5.2 The survival function stratified per nutritional predictor

In this subsection a different research question is addressed: what is the effect of nutritional status at different moments in life on (median) age at menarche. We study this by plotting the *survival function* stratified for selected nutritional predictors and by calculating *the median ages at menarche* given a certain nutrition status. As outlined in Chapter 5 (section 5.6), some of the respective nutritional status indicators are not independent but correlated, particularly when they pertain to the same stage in life (childhood, adolescence). We therefore selected one or two nutritional indicators per stage, i.e. adolescent stunting and CED according to BMI Z-scores, childhood stunting, and birth weight (Figures 6.15 to 6.18, page 184). Figures 6.15-6.18 show a consistent pattern: low (<-3 SD) nutritional status as indicated by the level of adolescent stunting and CED according to BMI Z-scores, as well as childhood stunting and birth weight corresponds with a higher (expected) median age at menarche for premenarcheal girls.

Figure 6.15: Survival function for adolescent girls showing the probabilty of being premenarcheal by age and stratified by level of adolescent stunting, Matlab 2001

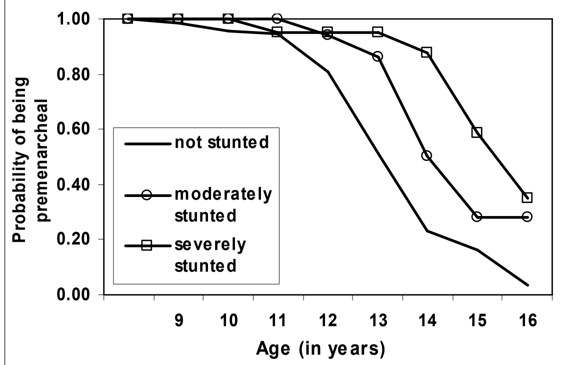


Figure 6.16: Survival function for adolescent girls showing the probabilty of being premenarcheal by age and stratified by level of CED according to BMI Z-scores, Matlab 2001

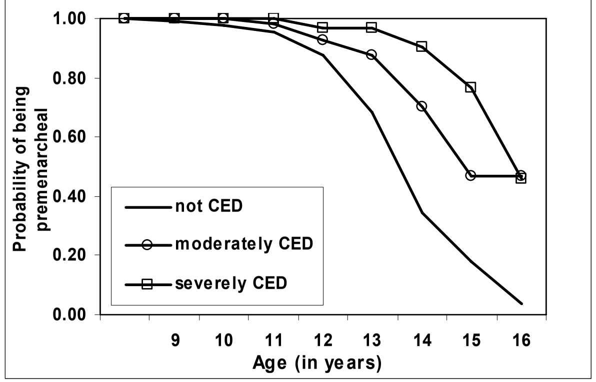


Figure 6.17: Survival function for adolescent girls showing the probabilty of being premenarcheal by age and stratified by level of childhood stunting, Matlab 1988-2001

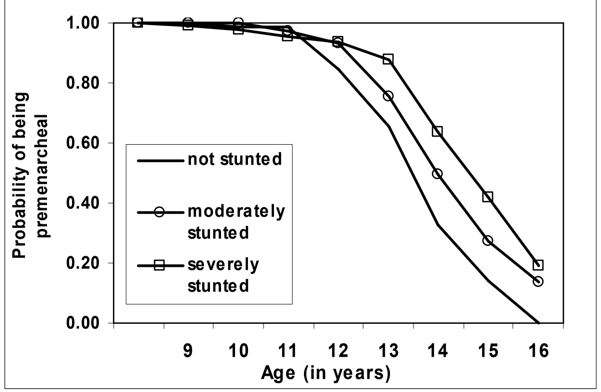


Figure 6.18: Survival function for adolescent girls showing the probabilty of being premenarcheal by age and stratified by recalled birth weight, Matlab 2001

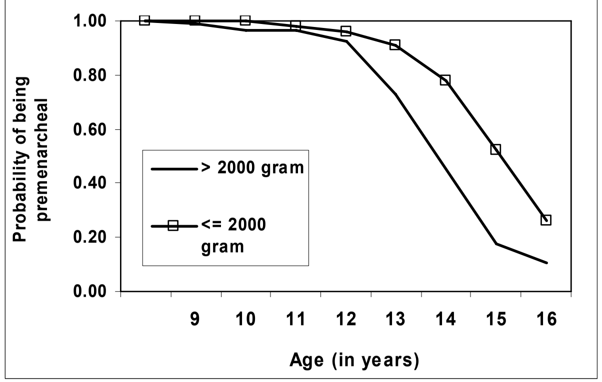


Table 6.10 presents the median age at menarche for girls with a certain ‘attribute’ (for instance being *severely* stunted in early childhood). For every nutritional indicator the ‘waiting’ time for turning from premenarcheal into postmenarcheal increases by a lower level of nutriotion status. For example, half of the girls who are *not* malnourished in terms of CED according to BMI Z-scores (>-2 SD) reach menarche at the age of 14.5 years, whereas their counterparts with *moderately* (between -3 and –2 SD) SED or *severely* (<-3 SD) CED reach menarche at the age of respectively 15.9 years and 16.9 years. Because of the nature of the study - a follow-up - of under-fives surveyed in 1988-1989 - the eldest girl in our sample is 16 years. As the number of *premenarcheal* girls of age 16 who are *severely* malnourished in adolescence or who had a birth weight of 2000 grams or less, is relatively small, the (expected) median age at menarche presented for these particular categories is 16 years and above.

Table 6.10 Median age at menarche (derived from lifetables) stratified by selected nutritional indicators, Matlab 1988-2001

Variables		Median age at menarche	n
Adolescent underweight	not underweight: >-2 SD	14.09	52
	moderately underweight: between -3 and -2 SD	14.65	69
	severely underweight: <-3 SD	16 plus	104
Adolescent stunting	not stunted: >-2 SD	14.04	71
	moderately stunted: between -3 and -2 SD	15.02	90
	severely stunted: <-3 SD	16 plus	64
Adolescent CED according to BMI Z-scores	not CED: >-2 SD	14.54	134
	moderately CED: between -3 and -2 SD	15.87	57
	severely CED: <-3 SD	16 plus	34
Childhood underweight	not underweight: >-2 SD	14.73	80
	moderately underweight: between -3 and -2 SD	14.69	80
	severely underweight: <-3 SD	15.78	91
Childhood stunting	not stunted: >-2 SD	14.47	86
	moderately stunted: between -3 and -2 SD	14.98	73
	severely stunted: <-3 SD	15.63	92
Recalled birth weight	> 2000 grams	14.83	81
	<= 2000 grams	16 plus	55

6.5.3 Application of the Cox regression model

Stratification is one approach to measure the impact of nutritional status on age at menarche. Another approach is the *Cox* regression model or proportional hazard model, which estimates an ‘average’ relative risk for all ages. It assumes that the rates of reaching menarche for girls of different nutritional status are proportional and the proportionality factor does not depend on age. The *Cox* model, like the *lifetable* and other techniques of survival analysis, makes use of the contribution of censored cases. The *Cox* model is a semi-parametric transition rate model.

The model is specified as follows:

$$r(x)=h(x)\ \exp[\alpha_1 z_1 + \alpha_2 z_2 + \ldots \alpha_i z_i],$$

where r(x) is the rate of menarche (transition rate, hazard rate) at age x, h(x) is the baseline rate, z_i is the i-th predictor of the age at menarche (covariate) and α_i is the impact of the predictor on the rate of reaching menarche. In the current application, z_1 to z_i relate to indicators of nutritional status in adolescence, early childhood or at birth, and maternal age at menarche. The baseline captures the effect of age and the second term captures the effects of covariates. The proportional hazard model assumes that the effects of covariates do not change with age. Here we do not consider whether the proportionality assumption may or may not hold in the sample of observations. We thus primarily aim to analyse whether age at menarche is dependent on nutritional status in adolescence, in early childhood and at birth (the last is indicated by birth weight).

Table 6.11 shows the univariate model, i.e. the model with a single covariate. For independent variables expressed as categorical, each category is compared to the reference category (*ref.*). Reference categories comprise girls who were *not malnourished* in adolescence and childhood according to anthropometry, or who had a birth weight above 2000 grams. In the table, only the main parameter of the model (*B*) is shown, along with the corresponding Standard Error (*SE*) and the level of significance of the parameter considered (*Sig.*).

From Table 6.11 we observe that with regard to predicting the rate of menarche all indicators of nutritional status in adolescence are (highly) significant. Consider the effect of adolescent stunting on the rate of menarche: girls who are *severely* (<-3 SD) stunted in adolescence have a rate of menarche that is 16 per cent ((exp-0.1821)*100) of the rate for girls who are not (>-2 SD) stunted in adolescence (the reference group). Similarly, girls who are *moderately* (between -3 and -2 SD) stunted in adolescence have a rate of menarche that is 42 per cent ((exp-0.857)*100) of the rate for girls who are *not stunted* (>-2 SD) in adolescence (the reference group). Given that a lower rate of menarche implies a higher age at menarche, these results reveal that girls who are *severely* stunted have the highest age at menarche.

The effects of childhood underweight and childhood stunting are only significant if the *severely* malnourished categories are considered. Girls who were *severely* (<-3 SD) underweight and stunted in early childhood have a rate of menarche that is respectively 48 per cent ((exp-0.734)*100) and 49 per cent ((exp-0.714)*100) of the rate for girls who were *not underweight* respectively *not stunted* (>-2 SD) in early childhood (the reference groups).

Although the correlation matrix on timing of menarche among *postmenarcheal* girls (see Table 6.9) did not show a significant effect of birth weight, the effect of this variable does become significant in the Cox regression analyses, where all girls, thus both *premenarcheal* and *postmenarcheal* girls, are considered. The regression analysis shows that girls born with a birth weight of 2000 grams or less have a rate of menarche that is 39 per cent ((exp-0.952-1)*100) of the rate for girls who were born with a birth weight of more than 2000 grams (the reference group). This means that girls with a low weight at birth reach menarche at a later age.

Table 6.11 Cox regression univariate model predicting the rate of menarche, Matlab 1988-2001

Variables	Categories, if applicable	B	SE	Sig.
Maternal age menarche (continuous)		-0.081	0.068	0.233
Adolescent weight (continuous)		0.110	0.015	**0.000*****
Adolescent height (continuous)		0.106	0.016	**0.000*****
Adolescent underweight	not underweight: >-2 SD (ref.)	-	-	**0.000*****
	moderately underweight: between -3 and -2 SD	-0.518	0.242	**0.033***
	severely underweight: <-3 SD	-1.771	0.289	**0.000*****
Adolescent stunting	not stunted: >-2 SD (ref.)	-	-	**0.000*****
	moderately stunted: between -3 and -2 SD	-0.857	0.233	**0.000*****
	severely stunted: <-3 SD	-1.821	0.364	**0.000*****
Adolescent CED according to BMI Z-scores	not CED: >-2 SD (ref.)	-	-	**0.000*****
	moderately CED: between -2 and -3 SD	-0.984	0.312	**0.002****
	severely CED: <-3 SD	-1.804	0.517	**0.000*****
Childhood underweight	not underweight: >-2 SD (ref.)	-	-	**0.006****
	moderately underweight: between -3 and -2 SD	-0.044	0.251	0.861
	severely underweight: <-3 SD	-0.734	0.270	**0.007****
Childhood stunting	not stunted: >-2 SD (ref.)	-	-	**0.022***
	moderately stunted: between -3 and -2 SD	-0.350	0.261	0.180
	severely stunted: <-3 SD	-0.714	0.259	**0.006****
Recalled birth weight	> 2000 grams (ref.)	-	-	-
	<= 2000 grams	-0.952	0.342	**0.005****

*	Significant at the 0.05 level
**	Significant at the 0.01 level
***	Significant at the 0.001 level

We also applied Cox regression to examine the effect of *continuous* independent variables (maternal age at menarche, adolescent weight and adolescent height). For instance, an increase in the age at menarche of the mother by one year would *reduce* the rate of menarche of the daughter by 7.8 [((exp-0.081)-1)*100] per cent, which in turn would imply a postponement of menarche of the daughter. However, maternal age at menarche did not appear to have a significant effect on the age of menarche, whereas adolescent weight and height did. An increase in adolescent weight and height of respectively one kg and one cm *increases* the rate of menarche by 11.6 [((exp0.110)-1)*100] and 11.2 [((exp0.106)-1)*100] per cent. Such an *increase* in rate of menarche related to a more adequate nutritional status in terms of weight and height implies a *decrease* in age of menarche.

This outcome raises the question of how the model *with* covariates (multivariate model) would look like. More specifically, we want to explore what the effect of a potential nutritional predictor is on the rate of menarche when controlling for other predictors included in the model. Five multivariate models are presented in Table 6.12. Again *B* is shown, as well as the level of significance which is asterisked. We selected some of the most salient models, i.e. the models that show a significant change when an additional predictor is added (except for models 4 and 5).

Table 6.12 Cox regression multivariate model predicting the rate of menarche, Matlab 1988-2001

Variables	Categories	Model 1 (B)	Model 2 (B)	Model 3 (B)	Model 4 (B)	Model 5 (B)
Adolescent underweight	not underweight: >-2 SD (ref.)	-	-	-	-	
	moderately underweight: between -3 and -2 SD	-0.265	-0.414	-0.383	-0.059	
	severely underweight: <-3 SD	-0.808	**-1.107***	**-1.028***	-0.602	
Adolescent stunting	not stunted: >-2 SD (ref.)	-	-	-	-	-
	moderately stunted: between -3 and -2 SD	**-0.727****	**-0.746****	**-0.884****	**-1.103****	**-1.440*****
	severely stunted: <-3 SD	**-1.132****	**-1.208****	**-1.504****	**-1.590***	**-2.893*****
Adolescent CED according to BMI Z-scores	not CED: >-2 SD (ref.)	-	-	-	-	
	moderately CED: between -2 and -3 SD	-0.290	-0.238	-0.241	0.125	
	severely CED: <-3 SD	-1.057	-0.977	-1.034	-1.708	
Childhood underweight	not underweight: >-2 SD (ref.)		-			-
	moderately underweight: between -3 and -2 SD		0.215			0.106
	severely underweight: <-3 SD		0.511			0.593
Childhood stunting	not stunted: >-2 SD (ref.)			-		-
	moderately stunted: between -3 and -2 SD			-0.061		-0.151
	severely stunted: <-3 SD			0.584		0.499
Recalled birth weight	> 2000 grams (ref.)				-	-
	<= 2000 grams				-0.704	-0.771
-2 Log Likelihood		773.854	771.796	769.149	296.764	300.168
Overall score Chi-square		**58.985*****	**61.116*****	**61.678*****	**35.938*****	**33.450*****
df		6	8	8	7	7
Change from previous step (Chi-square)		**57.570*****	**59.175*****	**61.822*****	**37.430*****	**34.026*****

* Significant at the 0.05 level
** Significant at the 0.01 level
*** Significant at the 0.001 level

We see from Table 6.12 that in line with previous findings, adolescent stunting stands out as the most significant nutritional predictor for the rate of menarche (models 1 through 5). Although adolescent underweight and BMI had a significant effect on the rate of menarche when considered on their own (see Table 6.11) they lose significance when they are considered together with adolescent stunting (model 1). Moreover, also childhood underweight (model 2), childhood stunting (model 3) and recalled birth weight (model 4) do not affect the strong effect of adolescent stunting on the rate of menarche. When considered together with the respective early life predictors of the rate of menarche in one model, the significant effect of adolescent stunting on the rate of menarche becomes even stronger (model 5). Taking model 5 as an example, we find that - when controlling for nutritional status in early life - girls who are *moderately* stunted (between -3 and -2 SD) in adolescence have a rate of menarche that is 24 per cent ((exp-1.440)*100) of the rate for girls who are *not stunted* (>-2 SD) in adolescence (the reference group). Similarly, girls who are *severely* (<-3 SD) stunted in adolescence have a rate of menarche that is 6 per cent ((exp-2.893)*100) of the rate for girls who are *not stunted* (>-2 SD) in adolescence (the reference group).

6.6 Conclusions and discussion

Basically, two elements constitute the focus of this chapter: age at menarche and its determinants, i.e. indicators of contemporary and early life nutritional status. The analyses that we presented were guided by hypotheses 1 to 3 (see subsection 3.2).

Age at menarche

We began with a description of (*observed*) age at menarche among the adolescent girls in our sample. The results revealed that among the 12 to16-year-old girls in our sample (n=255) many had not experienced menarche yet: the proportion of *postmenarcheal* girls increased from 7 per cent to 81 per cent among 12-year-old girls and among 16-year-old girls respectively. In our sample, 52 per cent of the *postmenarcheal* girls reached menarche at an age of 14 years or older, the cut-off point of what could be defined as a 'late' menarche, when compared to contemporary Western countries. In addition, 52 per cent of the *premenarcheal* girls was currently 14 years or older and therefore, according to this definition, 'late' with the onset of menarche. This latter figure can be regarded as a lower limit as it may increase if *premenarcheal* girls who are currently 12 or 13 years old do not experience menarche before their 14th birthday. *Lifetable* analyses, which allow for censoring, revealed that the median age at menarche among the girls in our sample is 15.1 years.

Age at menarche of mothers and daughters

We also studied the association between age at menarche of adolescent girls and that of their mothers. We did not find a significant correlation between a mother's age at menarche and menarche status of her adolescent daughter (all girls included), nor did we find a significant correlation between a mother's age at menarche and the age at menarche of her *postmenarcheal* daughter. Hence, we can reject *hypothesis 1*, which stated that timing of menarche of mothers and daughters is positively, though weakly, correlated.

As noted in subsection 2.4.2, cross-cultural trend studies show that age at menarche generally declines over time, at a pace of two months per decade (Becker 1993, p. 31). Given that this trend in age at menarche takes place in tenths of years, timing of menarche should be measured in months instead of years. Expressing age at menarche in full years, as we did, may not have been 'sensitive' enough to study a decline over two generations (mothers and daughters). We measured chronological age in months (i.e. date of birth and date of interview are expressed in years, months and days), but we did not consider it feasible to ask the girls to report on their age at menarche in months, let alone to ask their mothers such detailed information on menarche. The latter brings us to a potential pitfall: we collected data on menarche by *retrospective recall*. Particularly age at menarche as recalled by the adolescent girls' mothers may not be reliable because of the long time lapse. Although the recall method of reported age at menarche may not be optimal, it is often the only way of collecting this kind of information (Graham et al. 1999, p. 259). As also noted in section 3.3, accuracy of short-term recall among adolescent girls is relatively good (Koo and Rohan 1997, pp. 61-64) and there is also some evidence that long-time recall errors are fairly random, i.e. they show "no systematic bias in retrospective reports" (Damon et al. 1969; Livson and McNeill 1962, both cited by Becker 1993, p. 23).

Age at spermarche

With regard to the timing of spermarche among the adolescent boys in our sample, it is important to note that only 40 (out of the 260 boys of whom information is available about this topic) affirmed having experienced this event. The distribution of adolescent girls and boys who have experienced respectively menarche and spermarche showed that at every age between 12 and 16 years, girls are more advanced in terms of reproductive development than boys are. A case in point is that among 14-year-olds, 40 per cent of the adolescent girls is postmenarcheal in contrast to 4 per cent postspermarcheal boys.

Next, conclusions are discussed with respect to the relation between menarche and indicators of nutritional status pertaining to the three stages in life that we considered in this study. We first discuss the relation between menarche and nutritional status in one particular stage in life. Then we discuss the effects of all potential nutritional predictors on age at menarche that we considered together in multivariate models, by addressing the question of what the main effect of a variable is while controlling for the others. More specifically, we aim to review a) what stage in life (adolescence, early childhood or birth) is most important with respect to the influence of nutritional status on menarche attainment; and b) within this stage, what type of nutritional status indicator (underweight, stunting or BMI) has the strongest effect.

Menarche and contemporary nutritional status

Regarding the potential influence of contemporary - adolescent - nutritional status on menarche, we found that among our sample of *premenarcheal* and *postmenarcheal* girls, *menarche status* is significantly correlated with adolescent weight and height (positive), meaning that the higher a girl's weight and height in adolescence is, the more likely it is that she is *postmenarcheal*. In addition, *menarche status* appeared to be significantly correlated with adolescent underweight, stunting and BMI (negative), meaning that the more adequate a girl's nutritional status in adolescence is according to these three anthropometric indices, the more likely it is that she is *postmenarcheal*.

Also from the descriptive analyses (section 6.3) we learned that, at every age between 12 and 16 years, premenarcheal girls are more likely to be underweight and stunted than their postmenarcheal peers. Moreover, among *postmenarcheal* girls in our sample, *timing of menarche* (on time versus late) is significantly correlated with adolescent stunting (positive), meaning a *postmenarcheal* girl who is stunted in adolescence is more likely to have experienced menarche at an age of 14 years or older (*late menarche*). This corroborates findings from the earlier presented descriptive analyses. Also the *lifetables* stratified by nutritional status indicator revealed that particularly girls who are *severely* (<-3 SD) malnourished in terms of stunting and CED according to BMI Z-scores in adolescence (as well as childhood) have a higher median age at menarche.

Menarche and early childhood nutritional status

Age at menarche may also be influenced by early life nutritional status. We did find evidence in favour of *hypothesis 2*, which states that adolescent girls who were malnourished according to anthropometry as an under-five child are more likely to reach menarche 'late' as compared to their well-nourished counterparts. The descriptive analyses revealed that at every age between 14 and 16 years, the levels of *severely* (<-3 SD) underweight and stunting in childhood are considerably higher for *premenarcheal* girls as compared to their *postmenarcheal* peers (section 6.4). Particularly early childhood stunting seems to be an important determinant of age at menarche. The correlation matrix showed that *late menarche* is significantly correlated with malnutrition in childhood as indicated by level of underweight and stunting. However, as we will discuss later - while elaborating on the multivariate models - the effects of early childhood nutritional status indicators on age at menarche lose significance when adolescent stunting is taken into consideration.

Menarche and birth weight

Hypothesis 3 stated that adolescent girls who were born with a low birth weight experience menarche earlier than girls with a higher weight at birth. We found a *premenarcheal status* to be significantly correlated with a low birth weight. However, this association does not take into consideration the girl's age at interview. We did not find a significant correlation between *late menarche* among postmenarcheal girls and low birth weight. The univariate Cox regression shows a significant effect of birth weight on the rate of menarche. Birth weight loses its effect when other nutritional predictors - notably adolescent stunting - are taken into consideration.

It has to be emphasised that we need to be careful with drawing conclusions on the basis of the birth weight data as they are collected by retrospective recall of their mothers in 2001. The earlier made remarks about potential pitfalls on the quality of data recalled after such a long time applies here as well. In addition, it is important to keep in mind that there is as yet no agreement regarding the relevant 'critical period' that determines the age at menarche (Rich-Edwards 2002, p. 28). More recently, there is growing support for the possibility that timing of menarche may be set in utero or early in life but that it may be modified by changes in body size and composition in childhood (Silva et al. 2003, pp. 405-412), a line of thinking which relates to the Barker hypothesis. However, one should exercise caution as only a handful of reports hint at foetal determinants of age at menarche (Rich-Edwards 2002, p. 27) and some studies did not find a detectable effect of in utero famine exposure on age at menarche (see, for instance, Lumey and Stein 1997, p. 1964; Khan et al. 1995, p. 1092).

Our Bangladeshi sample differs in at least three aspects from the Dutch girls constituting the *Dutch Famine Birth Cohort* on which Lumey and Stein based their research. First of all, the Dutch girls are not likely to have grown up in deprived conditions from birth onwards, and consequently had more opportunities to catch up on growth. Secondly, their exposure to famine was concentrated in a period encompassing five critical months, whereas the girls in the Bangladeshi sample face malnutrition from birth or even conception onwards. The third factor relates to the concept of 'embodied health status', which was brought forward as a possible factor that held down the rate of stillbirths in mothers exposed to the Dutch famine (Hart 1993). The rationale behind this concept was that these Dutch women profited from the intrinsic 'embodied' nutritional status of the regional population, arising from favourable circumstances for growth and development among successive generations of mothers. In our Bangladeshi sample, 20 per cent of the girls' mothers is shorter than 145 cm and therefore malnourished in terms of height and 49 per cent has a BMI of 18.5 or lower, indicating Chronic Energy Deficiency (section 5.5). In Bangladesh, late menarche could well reflect an impaired nutritional status of previous generations (and thus be embodied). Age at menarche would not only be a lifecourse indicator of an adolescent girl's reproductive health status, but could also be considered a 'multi-lifecourse' indicator of multiple generations' reproductive health status.

Menarche and all potential predictors considered together

The *univariate* Cox regression model confirmed that, apart from maternal age at menarche, every nutritional indicator included in the analyses has a significant effect on the rate of menarche when considered separately. For instance, *severely* (<-3 SD) stunted and *moderately* (between -3 and -2 SD) stunted adolescent girls have a rate of menarche that is respectively 16 and 42 per cent of the rate for girls who are *not stunted* (>-2 SD) in adolescence (the reference group). This means that girls who are *severely* stunted in adolescence have the highest age at menarche. Also significant effects on the rate of menarche were found for *severely* underweight and stunting in early childhood. Girls who were *severely* (<-3 SD) underweight and stunted in early childhood have a rate of menarche that is respectively 48 and 49 per cent of the rate for girls who were *not underweight* respectively *not stunted* (>-2 SD) in early childhood (the reference groups).

When the potential nutritional status indicators are analysed together in the *multivariate* Cox regression models, it appears that adolescent stunting stands out as the most important determinant of age at menarche. When controlling for the respective early life predictors (i.e. childhood underweight, childhood stunting and birth weight), the significant effect of adolescent stunting on the rate of menarche becomes even stronger. Can we conclude now on the basis of these models that *only* adolescent stunting is important for menarche attainment and that adolescent weight (or weight-for-age) and nutritional status in early childhood are not factors of importance? Probably not. Given that in extreme situations (famine, diet, physical exercise) menstruation (temporarily) stops (Napieralski and Devine 1998, p. 3) there must be a minimum of nutritional intake for reproductive functioning. Such a minimum - or as Frisch and Revelle (1971) term it "critical weight" - is also likely to be present for the first menstruation, menarche. Adolescent stunting is indeed the most important predictor of age at menarche, but given the strong correlation between stunting in early childhood and adolescence, which we found in Chapter 5 (section 5.6), the aforementioned significant effect of stunting in adolescence on menarche still resonates from the effect of stunting in early childhood. Following the same line of thinking, effects of nutritional status of the previous generation (the adolescent girls' mothers) should also not be ruled out as a factor possibly (indirect) influencing age at menarche. Although maternal height does not have a significant effect on the rate of menarche (not shown), as discussed in Chapter 5 (section 5.6), it did appear to be an important determinant of adolescent stunting as well.

In terms of implications of these findings for intervention, the obvious recommendation would be to improve contemporary as well as early childhood nutritional status of girls. It could however be hypothesised that an improved nutritional status may lead - via earlier menarche - to earlier marriage and ultimately childbirth. Such a process may be mediated through more appealing looks and a presumed relatively higher socio-economic status which are both associated with good nutritional status, whereas better nourished girls also appear physically stronger and more mature (Riley 1994, p. 88). Riley found a girl's nutritional status in Matlab to be negatively correlated with age at marriage (Riley 1994, p. 97). In a longitudinal nutritional intervention study undertaken in Guatemala it was however ascertained that better growth in early childhood did indeed result in earlier childbirth - the median age at first birth was 1.04 year earlier - even after controlling for socio-economic status, but that the effects of *schooling* in delaying fertility milestones were larger in magnitude (Ramakrishnan et al. 1999, pp. 2196-2202).

Finally, as elaborated in Chapter 2, young *gynaecological* age is only one side of the coin: socio-cultural norms favouring early marriage and childbirth complete the framework of the study on adolescents' reproductive health. A possible suggestion is that if a girl's *gynaecological* age is young, and related to this, her nutritional status is poor, it would be favourable to postpone marriage and childbearing in order to allow the girl to mature fully (particularly in terms of height and pelvic size). We need to bear in mind however that within the Bangladeshi cultural setting the idea of postponing marriage may not be acceptable. Earlier sexual maturation and an extended period during which the adolescent could *socially* develop may give rise to intergenerational conflicts and insecurity among the adolescents concerned due to conflicting influences of "what are perceived as modern codes of behaviour on the one hand and traditional practices on the other" (WHO 1975, p. 12). With regard to Bangladeshi society the latter may relate to *purdah* and *izzat* (see also subsection 2.4.3). A girl who delays marriage may be more exposed to premarital sexual relations, and as a consequence may be more vulnerable to unwanted pregnancies and STDs including HIV/AIDS. There is evidence that these problems have increased among young people in most societies in which the average age of marriage has increased (Friedman 1999, p. 3). However, we believe that such a risk does not outweigh the advantages of improved nutritional status, early menarche and later marriage, and the increased possibilities to pursue higher education due to the later onset of the marital career. Moreover, the increased vulnerability to unwanted pregnancies, STDs and HIV/AIDS could be addressed by improving adolescents' knowledge about reproductive matters and by increasing their accessibility to reproductive health services and care. The next chapter examines adolescents' knowledge and perceptions about reproduction health.

7 Adolescents’ reproductive health as indicated by their knowledge and perceptions

7.1 Introduction

The aim of this chapter is to shed light on aspects of reproductive well-being in adolescence from a mental-emotional perspective (research question 5, section 1.3). We analysed interviews on knowledge and perceptions about the onset of menarche, spermarche and reproductive issues that relate to contemporary and future stages of the reproductive health career. Throughout this chapter, the 'voices' of the adolescents and some of their 'important others' (mothers, fathers, key informants) are presented. It should be noted that these voices are in an italic font and the most salient phrases are in bold. For reference to the meaning of some Bangla words that are not translated, see Appendix A.

The analyses presented in this chapter are based on data derived from two sources (see section 3.7):

- the follow-up survey; and
- in-depth interviews with selected (unmarried and a few married) adolescents, several mothers and fathers of adolescents, two ghatoks (matchmakers) and a local youth counsellor.

This chapter is structured in three parts. The first part (section 7.2) refers to the (merely) social significance of reproductive transitions in adolescence, and reflects how the adolescent girls and boys in our sample perceived the onset of menarche and spermarche respectively (subsection 7.2.1) and menstruation in general (subsection 7.2.2). The second part (section 7.3) addresses adolescents' knowledge and perceptions of (adolescent) development whereby we focus on (other) perceived indicators of development (subsection 7.3.1) and sources of information on physical maturation (subsection 7.3.2). The third part (section 7.4) outlines the adolescents' knowledge and perceptions about topics and events that pertain to future reproductive health but for which they (may) need to be prepared already. We subsequently discuss the adolescents' knowledge of human procreation (subsection 7.4.1), their views about the timing of marriage and risks associated with early childbearing (subsection 7.4.2), their knowledge of contraception (subsection 7.4.3) and their awareness with regard to HIV/AIDS (subsection 7.4.4). Conclusions are discussed in section 7.5.

7.2 Social significance of reproductive transitions in adolescence

In this section we discuss knowledge and perceptions among adolescent girls and boys on menarche and spermarche respectively (subsection 7.2.1) and menstruation in general (subsection 7.2.2).

7.2.1 Knowledge and perceptions about menarche and spermarche

We start this section by discussing the first reaction of *postmenarcheal* adolescent girls (n=86) and *postspermarcheal* adolescent boys (n=40) on experiencing menarche and spermarche respectively, and then link this reaction to the extent of 'preparedness' to these reproductive transitions. Though there were 97 postmenarcheal girls enrolled in our study, 11 girls did not feel comfortable or were not allowed to talk about menarche further; hence, the lower number of cases. The results are shown in Table 7.1.

Table 7.1 First reaction of adolescent boys and girls on the onset of spermarche and menarche respectively, Matlab 2001 (%)

I felt mainly ……	Boys (%)	Girls (%)	Total (%)
Scared	33	64	55
Surprised	40	9	19
Good	5	2	3
Confused	3	2	2
Shameful	0	4	2
Don't remember I how felt	19	19	19
n	100 (n=40)	100 (n=86)	100 (n=126)

Table 7.1 reveals that no less than 64 per cent of the girls and 33 per cent of the boys felt mainly scared after experiencing menarche and spermarche, respectively. '*I was mainly surprised'* best reflected the state of mind of 40 per cent of the boys and only 9 per cent of the girls. Likewise being *'scared'*, feeling *'surprised'* seems to indicate 'ignorance' (in the sense of 'not being informed'), but being surprised is a more positive emotion than being scared. About one-fifth of the adolescents did not remember how they reacted to this reproductive transition or failed to find words to describe it. Only a few adolescents - 5 per cent of the boys and 2 per cent of the girls - felt good afterwards, whereas on the other hand also a few adolescents were confused. Several girls, 4 per cent, indicated that they felt mainly *'shameful'* about experiencing menarche whilst none of the boys felt this way about spermarche.

The salient difference between boys and girls with regard to the scores on 'scared' and 'surprised' may be due to the very nature of menarche and spermarche. As indicated by some of the girls and boys in the in-depth interviews, starting to bleed out of the blue seems to be a far more fearful event than waking up with a wet patch.

> Girl, 15 years: *My first menstruation started when I was 15 years old.* ***I became afraid when I discovered that my body was bleeding****. I talked about* ***'sharil kharap' (body is not well)*** *with my grandmother in the bari. My* ***mother knows*** *when I menstruate. During my menstruation I use specific underwear and pieces of clothes for this period. I also stop fetching water, cleaning the ghar and going anywhere. I perceive menstruation* ***positively because it makes the body fresh****. After bleeding all the* ***bad blood has come out****. I do not feel good enough to move during this period. I have* ***pain*** *in my stomach.*

> Girl, 16 years: *I started to menstruate when I was 15 years old****. I started bleeding but was not upset because I was prepared and informed*** *that this would happen by bandhobi and friends at school.* ***My mother does not know*** *that I am already menstruating.*

> Boy, 13 years: *Spermarche started when I was 12 years and 8 months old.* ***My friends informed me about spermarche before****. They told me that it would start as I get older.* ***Therefore I did not feel awkward when it happened****. All boys experience*

> *spermarche. It happens during sleep and then your lungi gets wet from semen. I* ***talk to friends and my cousins about it*** *in the bari. We refer to spermarche with the term 'dhatu jaoya' (passing semen; semen going out). I think spermarche is* ***quite normal****. Every boy has spermarche as he gets older but if one has thoughts while it happens it is* ***shameful****. Health will also be* ***weak*** *after spermarche. It is universal, comparable with something like a child that will be born after a husband and his wife had sex.*
>
> Boy, 15 years: *I experienced spermarche at the age of 12 years.* ***I was both afraid and surprised when it happened.*** *It is* ***bad for health****. My friends and I refer to masturbation with the words 'dhatu jaoya' (passing semen; semen going out) and 'mall jaoya' or 'Dhaka jaoya' (****going to Dhaka****). I perceive it as* ***something negative*** *because your* ***body is not holy*** *anymore after having masturbated. It happens when you think about* ***bad*** *things, such as sexual things about girls. One may also have a painful penis afterwards.*

The picture that emerges from the interviews echoes the results as presented in Table 7.1 ('*scared*' and '*surprise*'). What is also indicated by the interviews is that because of its association with masturbation, spermarche has a negative connotation, indexed by the words *'shameful'*, *'bad'*, *'not holy'* and *'going to Dhaka'*. The last expression should be interpreted as the equivalent as a 'place of sin' (where, for instance, brothels are found). As also described in subsection 2.4.2, masturbation is seen as something shameful within the Bangladeshi society, not in line with Islam and possibly harmful to health (Aziz and Maloney 1985; Khan et al. 2003). Despite this, as appeared from the in-depth interviews, boys do talk about it mutually. The link with health was also pointed about by two adolescent boys (*'health will be weak afterwards'* and it is *'bad for health').*

The interviews also provide information on other cues with which menarche (or menstruation in general) and spermarche can be discussed. For instance, the perceptions about menstruation blood (notably its polluting nature), sources of information, the possible taboo on discussing menarche between mothers and daughters (*'my mother knows'* versus *'my mother does not know that I am already menstruating'*), and the association with health in general (*'it makes the body fresh'*). These viewpoints will be addressed later in this section.

Preparedness

In the follow-up survey, we asked postmenarcheal girls whether they were informed about *mashik,* the general term indicating menstruation, before it started. It appeared that an increasing majority by age, up to 75 per cent among the 16-year-old girls, indicates that they were indeed familiar with this term before its actual onset. This percentage may seem quite high, particularly in view of the finding that 64 per cent of the girls remembered feeling afraid when they reached menarche (Table 7.1). Possibly, they were indeed informed but this information could not prevent them from becoming afraid. It is also possible that during the interview, postmenarcheal girls were not able to distinguish between knowledge they gained *before* and knowledge they acquired *after* they had reached menarche.

In the in-depth interviews, none of the adolescent girls and mothers was able to tell us about the *biological* pathways and facts about the origin of menstruation:

Girl, 15 years: *I do not know why a woman menstruates.*

Girl, 13 years: *Women have sexual contact with their husband and also* ***do*** *many things, so menstruation continues. It begins with pain in the head and belly, and then menstruation starts.*

Mother, 34 years: *Menstruation makes the body free from bad blood. Women menstruate because it is the* ***will of Allah*** *and that is why we keep menstruating.*

Mother, 34 years: *When I have my menstrual period, I use underwear and separate cloths made of cotton. I also do not have sex with my husband during this period, and do not say my prayers, do not fast and do not read the Koran. I perceive menstruation* ***positively*** *because it is a* ***tradition belonging to women****. All bad blood comes out and the body will be good again. I only have problems moving around during these days. Women menstruate because it is a* ***rule of Allah****. Women give birth to children and if they do not have menstruation they cannot give birth. A woman needs menstruation to get pregnant.*

The mothers of adolescent girls attribute the origin of menstruation to Allah. Hence, women are subjected to religious behavioural restrictions during menstruation. It should be noted that this link with religion was not made by the adolescent girls. Possibly, for mothers menarche and menstruation are embedded within the larger 'religious ideology'. The association with Allah seems to give menarche and menstruation, particularly via childbearing, a religious significance. A similar notion was observed earlier, in subsection 2.5.1, with respect to motherhood where Blanchet remarked that motherhood is "more than a role, it is a religion" (1996, pp. 131-132).

Another association forwarded by the respondents, both girls as well as mothers, is the one between menarche or menstruation and reproduction. Given this link, the interviewed mothers seem to consider menstruation not to be a relevant subject for girls, particularly when they are still premenarcheal. As elaborated in subsection 2.4.3, this may be seen in view of the concept of 'understanding', i.e. what one is expected to know as morally good and to practise it according to one life's path and *dhormo* in life (Blanchet 1996, pp. 47-48). It closely relates to the concept of *jati* that includes one's hereditary religious or occupational group and gender (Blanchet 1996, p. 33). With regard to sexuality, 'innocence' is expected from adolescent girls and guilt and punishment are consequences for not observing the role according to the expected state of 'understanding' (Blanchet 1996, pp. 47-48). Apparently, menstruation is not a topic about which premenarcheal girls need to be educated according to their expected state of 'understanding'. As pointed out by one mother, informing her (premenarcheal) adolescent daughter about menstruation would make the girl unnecessarily precocious:

Mother, 33 years: *I do not talk to my daughter about menstruation because this would* ***make her lose her modesty****.*

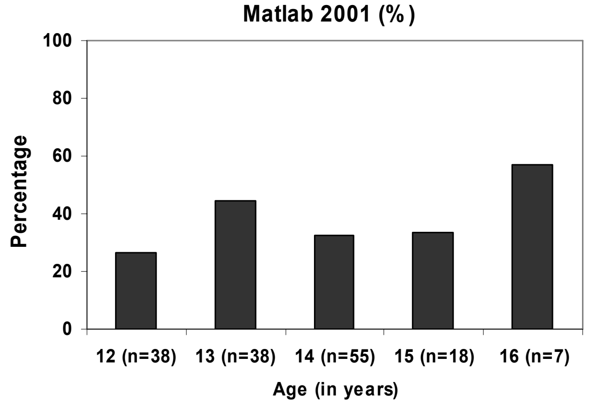
Also some interviewed boys were left in the dark regarding the onset of spermarche, although they do associate its onset with increasing age. A case in point in this respect is an excerpt from an interview with an adolescent boy who relates the occurrence of spermarche to a surplus of calcium intake:

> Boy, 16 years: *I experienced spermarche at the age of 13 years. **I was afraid and felt weak then**. Friends informed me and told me it comes when you grow up. I talk to friends about masturbation. We call it 'ratre swopne Dhaka jaoya' (going to Dhaka at night; going to Dhaka during a dream) or 'dhatu gache' (passing semen; semen going out). I think masturbation is **bad and shameful. It is not good and also not good for health.** One becomes weak and gets a headache. Spermarche happens when you grow up. It also **happens when one has taken too much calcium**.*

More boys in our sample talked about this association with calcium intake. We also heard about an opposite relation: that spermarche (and masturbation) would cause a calcium deficiency as a consequence of which skeletal growth would be hampered.

In the follow-up survey, it was also explored to what extent *premenarcheal* girls are prepared for menarche. They were asked whether they knew what is meant by the term *mashik*, and in case they knew, whether they knew at what age a girl usually starts to menstruate. A minority of the premenarcheal girls (35 per cent) heard about *mashik* (n=156). These girls estimated the average age at onset of menarche to be 13.7 years with upper and lower limits of 10 and 16 years. This average is relatively low in view of the expected age at menarche of 15.1 among the girls in our sample (see subsection 6.5.1). One would expect that knowledge about menstruation increases with age but this is not necessarily the case, as we can see from Figure 7.1, which shows the distribution of premenarcheal girls who have heard about *mashik*. Except for (the very few: n=7) 16-year-old girls, at every age the majority of the premenarcheal girls is not familiar with *mashik*. Among 14-year-old premenarcheal girls, over two-thirds (67 per cent) indicated that they did not know what this term meant.

Figure 7.1: Premenarcheal girls who heard about 'mashik' by age at interview, Matlab 2001 (%)



Adolescent boys were also asked this question (not shown). It appeared that 19 per cent of the adolescent boys knew about *mashik* (n=260). When broken down by age this proportion of boys who know about *mashik* increases by age, from 8 per cent among 12-year-old boys to 30 per cent among 16-year-old boys.

In line with what we observed before, among the *premenarcheal* girls who were familiar with *mashik*, it were mostly friends (in 68 per cent of the cases) who provided them with information. The second most often reported source of information was a sister-in-law (15 per cent). Mothers were hardly mentioned as a source of information about menstruation. Also from the literature review (see subsection 2.4.3), it seems entrenched within the Bangladeshi society that mothers do not or hardly talk to their daughters about menstruation. However, it is probable that in their role of auntie, sister-in-law or friend, mothers are indeed important carriers of information for other girls.

An emotion like feeling scared as well as the more positive connotation of feeling surprised after the onset of menarche or spermarche may be shared with others. In both cases one may expect adolescents to seek contact with other people, either for reassurance or for information:

> Girl, 16 years: *I did not talk about it the first time, but when I got my second menstrual period I turned to my* ***friends****.*

> Boy, 15 years: ***Friends*** *told me that boys would have this at the age of 12 or 13 years.*

In the follow-up survey we asked *postmenarcheal* girls and *postspermarcheal* boys whether they had talked to someone after they experienced menarche and spermarche respectively (Table 7.2).

Table 7.2 Distribution of adolescent boys and girls who talked to someone after experiencing spermarche and menarche respectively, and their relationship to that person, Matlab 2001 (%)

Talked to somenone?		Boys (%)	Girls (%)	Total (%)
No, I never discussed it with anyone		65	15	31
Yes, to my:	friend(s)	35	19	24
	sister(s)	0	17	12
	aunt or cousin	0	17	12
	mother	0	16	11
	sister(s)-in-law	0	12	8
	grandmother	0	4	2
n		100 (n=40)	100 (n=86)	100 (n=126)

Girls and boys reacted quite differently to this question. Whereas girls have a rather broad social circle, notably female friends and close relatives with whom they talk after they experienced menarche, the majority of the boys, 65 per cent, appear to have coped with spermarche in silence. The remaining 35 per cent of the boys discussed it with friends. Among girls, 15 per cent kept the onset of menarche to themselves. In the literature review (subsection 2.4.3) it was clear that mothers in Bangladesh do not easily talk to their daughters about menstruation since it is generally believed to be a sensitive topic. We observed that relatively few girls (16 per cent) turned to their mother after their first menstruation:

> Girl, 13 years: *My first menstruation started when I was 11 years old. One day, I passed blood in my urine.* ***I was afraid and started crying.*** *In the bari, I have heard about it from my* ***chachi (auntie, mother's side)*** *and I talked about it with my* ***'fufu' (auntie, father's side)****. My mother knows when I menstruate.*

None of the girls whom we interviewed in-depth elaborated on the reasons for not talking about menarche with their mother. From some mothers we learned however that this sensitivity is rooted in the apparent shameful nature of talking about menstruation with one's daughter:

> Mother, 34 years: *My first menstruation started when I was 13 years old. I suddenly started bleeding and I was afraid.* ***My friends and brother's wife informed me about it.*** *I do not talk to my daughter about menstruation because this would be very* ***shameful****.*

> Mother, 34 years: *My first menstruation started 9 months after my marriage when I was 13 years. I remember that* ***I suddenly started to bleed and that I was afraid.*** *I turned to my girlfriend to talk to her about menarche. I would never talk to my children about menstruation because it is* ***a shameful topic****.*

In addition, this taboo on talking about menstruation between mothers and daughters may be in practice for a long time, considering that mothers were in their time also educated by a friend or other close relative rather than by their own mother.

Social significance of menarche and spermarche

The timing of menarche and - albeit probably to a lesser extent - spermarche are important from a physical perspective, but carry social significance as well (subsection 2.4.3). In order to gain more insight into the social significance of menarche and spermarche, we asked *postmenarcheal* girls and *postspermarcheal* boys in the follow-up survey whether the onset of these events had brought about, in their perception, distinct changes in their lives

Table 7.3 shows the percentage of adolescent boys and girls reporting on changes brought about by spermarche and menarche respectively (note that more than one answer could be given).

Table 7.3 Adolescent boys and girls reporting on physical changes after spermarche and menarche respectively, Matlab 2001 (%)

Changes as a result of spermarche/menarche: I ….	**Boys (%)**	**Girls (%)**	**Total (%)**
changed the way I used to dress	53	100	85
stopped taking baths alone in the river or in open areas of water	3	86	60
stopped sleeping with my father/mother in the same bed	23	73	57
started helping my father/mother with daily work	35	67	57
stopped going anywhere alone	0	81	56
stopped friendship with someone of the opposite sex	18	52	41
started to pray regularly	38	21	26
did not experience any changes in my life	18	0	6
n	40	86	126

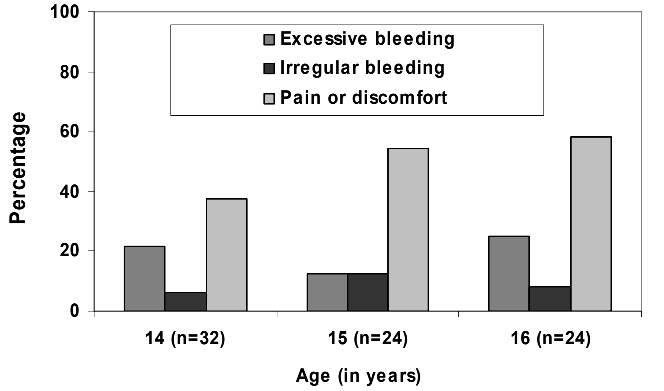
From Table 7.3 we learn that menarche and spermarche apparently have quite a different impact on the life of adolescent girls as compared to that of adolescent boys. Not only is the spectrum of changes broader among girls, but their lives also become more focused on the household and the home yard, as indicated by the high proportion of girls who started to help their mother with household work (67 per cent) and who stopped going anywhere alone (81 per cent). In addition, the majority of the girls mentioned that menarche implied no longer swimming or taking baths alone in open areas of water (86 per cent) and all girls changed the way they used to dress (for instance, starting to wear a *shelwar kamiz* or a *saree*, with an *orna* (scarf) to cover the girl's breasts and/or her head). Starting to wear different clothes was also the most reported change mentioned by boys, though only by 53 per cent of them. A typical change for adolescent boys appeared to be the importance of saying the daily prayers (38 per cent). Remarkably, only among some boys was it reported that there were no changes at all after the reaching of spermarche (18 per cent), whereas all girls mentioned at least one change in their lives after the onset of menarche.

That only half of the girls (52 per cent) and less than a fifth (18 per cent) of the boys mentioned no longer having friendship with someone of the opposite sex may need to be seen in view of the fact that many girls and boys did not have such friendships in the first place. As also described in subsection 2.4.3, these friendships were possibly already broken off or discouraged at an earlier age, in *kaisorer prarambha*, and hence, adolescents did not report about a change in this respect after menarche or spermarche.

7.2.2 Perceptions about menstruation

The discussion below on the perceptions of postmenarcheal girls on menstruation (n=86) relates to both *physical* and *mental* well-being within the reproductive domain. Excessive bleeding, irregular periods and pain or feelings of discomfort and may all affect reproductive well-being (Figure 7.2). According to the *postmenarcheal* girls who were interviewed in the follow-up survey, the average length of their menstrual period is 5.2 days. The girls perceived the average number of days between two of their menstrual periods to be 26.2 days[59]. In contrast to adult women, the cycles of adolescent girls in particular may be irregular due to the relatively recent maturation of their reproductive system (see subsection 2.5.1).

Figure 7.2: Specific complaints of postmenarcheal girls during menstruation by age at interview, Matlab 2001 (%)



From Figure 7.2 we see that at every age - we excluded the data pertaining to *postmenarcheal* girls of 12 and 13 years because of their low numbers - a minority of the girls indicates having irregular menstrual cycles (8 per cent irrespective of age). A considerable proportion of the girls indicated having pain during their menstrual period or general discomfort. This proportion amounts to 38 per cent among the 14-year-old girls and respectively 54 and 58 per cent among the 15 and 16-year-old girls. A closer look reveals that among this category, pain located in the lower abdomen constitutes the most common complaint (reported by 81 per cent of the girls within the 'pain or discomfort category'). Other types of pain or discomfort which girls directly attributed to their menstrual period are 'a general weakness' (mentioned by 44 per cent of the girls), headaches, moodiness and 'seclusion' or confinement (14 per cent of the girls). Pain and headaches were also mentioned in the in-depth interviews:

> Girl, 13 years: *I take special care of my health during menstruation: I wash cloths and nekra that become bloodied, but I do not clean the ghar, do not bring water and also do not go to school and Maktab (school where Islamic books are being read in the morning). To me* ***menstruation is trouble****. I cannot do anything and cannot go anywhere.* ***I feel very bad during these days.*** *I have* ***pain in my head, fever and pain in my belly****.*

That menstruation is perceived as 'trouble' (see above) is also indicated by the fact that many of the interviewed girls did not refer to menstruation with the general word *'mashik'* but used instead the term *'sharil karap'*, literally meaning 'body is not well'.

> Girl, 16 years: *Among friends we refer to menstruation with the words 'blood jay' (passing blood) and* ***'sharil karap'****.*

The following excerpt from an interview with an adolescent girl points to 'seclusion' or confinement, which entails the practice of staying at home or within the home yard during the entire period of menstruation and restraining from specific tasks, observing specific customs and, for instance, not going to school:

> Girl, 16 years: *When my menstruation starts I put on different cloths and use a nekra. I also sleep in a separate khat (bed) on those days.* ***I do not do any household work*** *during my menstrual period and* ***I also do not say any prayers****. In addition* ***I do not go to school****.* ***I perceive menstruation positively because otherwise I would not be able to become a mother****. A woman who does not have the ability to have children does not have any value. However,* ***I feel bad during my menstrual period because I cannot do any work and there is no place I can go to****. Women menstruate because they will become mothers of children.*

Despite the fact that a considerable proportion of the adolescent girls have some - merely physical - problems or complaints, which they attribute to their menstrual periods, menstruation is in general perceived positively, both by daughters and mothers in our sample, for a variety of reasons, notably the link to reproduction, as an identification of 'womanhood' and its association with 'good health' and the purging or washing away of the 'bad blood':

[59] This figure is slightly lower than those in other studies. For instance, among 16 to 20-year-old British girls the mean cycle length was reported to be 28.9 days (Monari and Montanari 1998, p. 95).

Girl, 16 years: *During menstruation I use a nekra and put on underwear. And I do not read the Koran nor do I say my prayers.* ***I perceive menstruation positively because it is good for health.*** *During this* ***period I become fat and look beautiful and will not catch any disease****. Sometimes I have pain in my belly and head. Women menstruate because they produce children*.

Mother, 33 years: *I take baths during the menstruation period and do not say my prayers. I perceive menstruation as something positive because all the bad blood comes out and my body gets well. On those days it is difficult to move.* ***Women menstruate in order to be able to give birth to children***.

Mother, 34 years: *When I am menstruating I take a bath and clean myself. I also do not say my prayers and I do not fast on those days. I perceive menstruation* ***positively*** *because all* ***the bad blood comes out*** *and this makes the* ***body fresh and slim****. I only feel uncomfortable moving around on those days. Women menstruate because it is Allah's will.*

Apparently, some of the conditions that are perceived as physical problems or complaints by the girls and mothers in our sample are to some extent outweighed by positive connotations of menstruation. Menstruation is seen as some kind of 'spring-clean', whereby the 'fat' body becomes 'fresh and slim', and menstruation happens for a good cause (fertility, children). The importance of the last factor underlies seemingly contrasting notions such as '*I perceive menstruation positively*' versus '*However, I feel bad during my menstrual period*', as mentioned by the foregoing mothers and girls.

Finally, as shown in Figure 7.2 a proportion of the girls interviewed in the follow-up survey perceived their menstruation as excessive bleeding. Excessive bleeding during menstruation does not necessarily result in anaemia in a girl or woman with a good nutritional and particularly iron intake, but it is indeed detrimental in case she is already malnourished and grossly iron deficient. As we learned from Chapter 5, malnutrition is indeed highly prevalent among the female adolescent population under consideration, with 46 per cent being *severely* underweight and 28 per cent being *severely* stunted (see Chapter 5). As indicated in Chapter 2 (subsection 2.5.2), adolescent girls in rural Bangladesh are likely to suffer from anaemia, with rates as high as 90 per cent found in a study of Shahabuddin et al. (2000). As shown in Figure 7.2, excessive menstrual bleeding is prevalent among respectively 22, 13 and 25 per cent of the 14, 15 and 16-year-old girls. Obviously, the interpretation of the term 'excessive' is subjective. We also inquired about the number of cloths used per day when menstruating. The latter information confirms that girls who complained about excessive menstrual bleeding do indeed use on average one item of cloths more per day (3.2 cloths) as compared to girls who report normal bleeding (2.2 cloths).

7.3 Knowledge and perceptions about adolescent development

Apart from menarche and spermarche there may be other signs that adolescents and their parents consider as indicators of the end of childhood and the beginning of adolescence. In this section we describe perceptions about other indicators of development (subsection 7.3.1) and outline the adolescents' sources of information of physical maturation (subsection 7.3.2).

7.3.1 Indicators of adolescent development

When asking adolescents and their mothers in the in-depth interviews about indicators that would reflect the onset of the adolescent stage in life, they tended to mention a certain age, which demarcated in their view the 'end of childhood'. Moreover they listed several physical characteristics or behaviours, which would typically signal that 'childhood was over':

> Girl, 13 years: *My childhood ended when I was 8 years old. Then **I no longer mixed with many people** and I **stopped quarrelling**. Also, changes have come with regard to my health. I have **grown up physically** and started **wearing clothes**.*

> Mother, 34 years: *My children's childhood ended at the age of 10 years. Then they were able to **realise things**, to **distinguish between good and bad**, and they started studying. By that time I could say that they had grown up and become smart: they had a good health, were **looking good physically** and had **appealing faces**. In the future I expect my children to be educated and good. My son will be a real man, an established man.*

Particularly the phrases extracted from the interview with the mother (*'realise things'* and *'distinguish between good and bad'*) reminds us of the earlier discussion about the concepts of *'understanding'* and *jati* (see subsection 2.4.2 and section 7.2). It is during late childhood or *balyakal* (6 to 10 years) and in the pre-adolescence period or *kaisor prarambha* that boys and girls increasingly learn the gender-specific roles that they are expected to play and consequently are addressed according to stage and gender: respectively *balok, balika* and *kishor*, *kishori* (Blanchet 1996, p. 38). The notions described by Blanchet corroborates our in-depth interviews in which ages of 8 and 10 years are mentioned as thresholds in the passage from childhood to adolescence. Adolescence may thus start earlier than at the onset of menarche.

We also discussed the concept of 'adolescence' with a local female youth counsellor, who has a more 'academic' view of adolescence, i.e. in accordance with the picture of adolescence as generally described in the literature (see subsection 2.4.1). She addresses 'adolescence' mainly from a physical point of view:

> Youth counsellor, 30 years: *The adolescent period ranges from age 12 to age 18 and is characterised by **physical and mental changes**. An adolescent develops knowledge in this period. Physical changes are for instance getting taller and becoming fat. Girls start to **menstruate** and their breasts will grow, whereas boys reach **spermarche**. Also, the face will change and the voice of a boy will change and he will grow a beard and moustache. For girls, the internal hormonal changes also underlie the growing of pubic hair. **Their lives change**. They may go to high school and develop relationships with friends.*

Physical changes as indicators of the ending of childhood and the beginning of adolescence were also mentioned by some of the mothers whom we interviewed in-depth, but in different words. A phrase that arose in these interviews with reference to this transition to adolescence is 'becoming fat':

> Mother, 33 years: *At the age of 10 years, my children had grown up, had **become fat** and now they are studying in the higher classes.*

Within the Bangladeshi society 'becoming fat' is also seen as an expression indicating 'good health'. During the fieldwork, we came across the notion of 'looking healthy' by which it was meant that someone was looking good as well as well looking well nourished. These two concepts are intertwined, which is not unusual given the close relationship between nutritional status and physical appearance. Rooted in this association as well may be the preference shown in Bangladesh for roundedness, voluptuousness, particularly regarding women and girls.

Bou-chee

An illustration of a game that prepares girls to live according to the norms and behaviours reflected by purdah is 'bou-chee' (Begum 2000, personal communication). This game is popular among girls aged 8 to 15 years in rural and semi-urban areas. As indicated by the Bangla word 'bou', meaning wife or housewife, the game teaches and prepares young girls for their future role as wife. The game is played by eleven girls. One of the girls is selected and stays in an imaginary house, indicated by a circle or square on the ground; five other girls are in another imaginary house, situated a few metres across the first house; and the remaining five girls walk freely in the area between both houses. The idea of the game is that the five girls in the 'opposite' house need to collect the selected girl from her house and take her to their home. Collecting and bringing home the selected girl is not easy as the other five girls that are running around freely can tag every girl who dares to come out of the house. As soon as a girl is tagged she is out of the game. Fortunately, a girl who travels outside the house is 'untouchable' as long as she is 'chee-ing', i.e. making a noise that sounds like 'chee'. Only by running fast, moving around quickly, and saying 'chee' as long as needed, a girl can 'save' the other girl's life.

Although obviously an exciting game to play, the indirect messages of the game are clear: stay in the house as this is the only safe spot; it is full of dangers outside; and, related to this, wait for someone to accompany you when you want to walk from one house to another. The two houses may symbolise the house of the girls' family and her future in-law-house.

It is not known whether there are also such games for boys in which the adult role is taught as explicitly. An example of a game played by boys of different ages is a game 'dangoli' (Begum 2000, personal communication). A short stick is laid in a hole in the field and two boys compete with each other in throwing this stick as far as possible. Lifting and throwing of the stick is done with help of a larger stick that is put underneath the short stick in the hole. The boy who throws the largest distance between the spot where the short stick has landed and the hole (expressed in units of the large stick) is the winner of the game. Apparently the normative message for boys relates to the importance of strength and physical capabilities.

In the follow-up survey, adolescent girls and boys were also asked about bodily changes while growing up and when these changes had - in their view - started. The average reported ages at which the adolescent boys and girls thought their body started to change were respectively 9.7 and 10.9 years. The figures reported by the adolescents contrast with the general idea that physical, and particularly reproductive, development develops earlier for girls as compared to boys (see section 2.4). With regard to the characteristics of changes, girls and boys tended to give similar answers (Table 7.4).

Table 7.4 Adolescent boys and girls reporting on physical indicators of adolescence, Matlab 2001 (%)

Reported indicators of change	Boys (%)	Girls (%)	Total (%)
Becoming taller	94	82	88
Weight gain	63	33	48
Changes in face	49	32	40
Breast development	1	72	24
Reaching menarche/spermarche	15	29	22
Breaking of voice	39	0	20
Growing pubic hair	21	7	14
Appearance of acne or pimples	4	2	3
Change of body colour	2	1	1
A better health condition	2	0	1
Do not know of any changes	0	1	1
n	260	242	502

Most adolescents reported about an increase in height (88 per cent), weight gain (48 per cent) and changes of features or looks of one's face (40 per cent). Many girls also mentioned in addition the development of breasts (72 per cent) whereas some boys indicated also the breaking of voice (39 per cent) and the growing of pubic hair (21 per cent). Only 7 per cent of the girls report about the last change. Very few non-physical changes (not shown) were mentioned by the adolescents. They associated adolescent development with gaining knowledge and - only mentioned by girls - becoming shy. These data indicate that the adolescents in our sample seem in general able to observe and talk about their development.

As Table 7.4 shows, the adolescent boys did not mention circumcision. Circumcision generally takes place before a boy is believed to reach sexual maturity (see section 2.4.3). The boys enrolled in the follow-up survey reported their circumcision at the age of 7.1 years on average. Circumcision is a major event, celebrated in public, and hence, not surprisingly only 3 per cent (n=260) of the boys did not remember his age at circumcision. Remarkably, five boys claimed to be 'God-gifted circumcised', which was in their view 'a welcomed curiosity'.

7.3.2 Sources of information about physical maturation

An important aspect of mental reproductive well-being is the question of whether the adolescents are *informed* about physical maturation in this stage of life. Only a minority of the adolescents in the follow-up survey, 14 per cent of the boys and 34 per cent of the girls respectively, stated that they were informed about physical changes before their actual onset (n=475).

As outlined in Table 7.5, among the adolescent boys who did receive some kind of preparatory information (n=35), friends constituted the most important source of information (62 per cent), followed at a distance by their mother (9 per cent), sister or brother (9 per cent), uncle, aunt or cousin (9 per cent), and grandmother or grandfather (5 per cent). Fathers only play a marginal role with regard to education of their sons about physical growth and development processes.

Table 7.5 Information sources about adolescent development of adolescent boys and girls, Matlab 2001 (%)

First mentioned source	Boys (%)	Girls (%)	Total (%)
Friend or neighbour	62	11	28
Mother	9	31	24
Sister or brother	9	15	13
Uncle, aunt or cousin	9	15	13
Sister- or brother-in-law	3	12	9
Grandmother or grandfather	5	10	7
Father	3	3	3
Health and Family Planning worker	0	1	1
Employer	0	1	1
Teacher/ school	0	1	1
n	100 (n=35)	100 (n=74)	100 (n=109)

Adolescent girls (n=74) have a less distinctive source of information, but rather a broad group of people to fall back on. Contrary to what was observed earlier while discussing about whom girls turned to when they reached menarche, mothers do furnish their daughters with information about general physical growth and development processes in adolescence. Almost one-third (31 per cent) of the girls was informed by her mother about bodily changes. Other important sources were a sister or brother (15 per cent), uncle, aunt or cousin (15 per cent), *bhabi*, i.e. a brother's wife or sister-in-law (12 per cent), grandmother or grandfather (10 per cent). A few adolescent girls received information from rather formal sources such as a Health or Family Planning worker or an employer. The role of the school is virtually non-existent in this respect.

It should be recalled that these figures pertain to the small number of adolescents (n=109) who were indeed informed. It is worth emphasising that the majority of the boys and girls, 77 per cent, is not informed about bodily developments. This finding, along with the observation that the most important sources of information are friends and close relatives, and not 'formal' sources such as health workers, school and the media (not mentioned), is important for educational campaigns for adolescents.

7.4 Knowledge and perceptions pertaining to future reproductive health

Having an understanding of reproductive development may be considered a prerequisite of (contemporary and future) *informed choice* particularly with regard to the adolescents' future reproductive health career. In this section we subsequently discuss the adolescents' knowledge about human procreation (subsection 7.4.1), perceptions about timing of marriage and childbirth (subsection 7.4.2), knowledge about contraception (subsection 7.4.3) and awareness of HIV/AIDS (subsection 7.4.4).

7.4.1 Knowledge about procreation

In the follow-up survey, we inquired - in an open question - about the adolescents' knowledge about human procreation (for girls: *Do you know how a woman can get pregnant?*; for boys*: Do you know how a man can become a father?*). The majority of the 485 adolescents, 84 per cent of the boys and 71 per cent of the girls, state that they are informed. At a first glance these figures are quite high, but when we asked to explain or discuss the reproductive process, the answers were less convincing (Table 7.6).

Table 7.6 Distribution of adolescent boys and girls reporting on 'human procreation', Matlab 2001 (%)

How to become a father/mother?	Boys (%)	Girls (%)	Total (%)
After marriage	54	27	42
After intercourse	29	49	37
By living together	9	15	11
After sex	4	8	6
By means of a man	2	1	2
Sleep with each other	1	0	1
Bringing sperm into the woman	1	0	1
n	100 (n=219)	100 (n=158)	100 (n=377)

Over half of the boys, 54 per cent, and 27 per cent of the girls reported that a pregnancy occurs 'after marriage' (*'ekotre bash kora'* or *'biyer-por'*). Though this is most probably the case within the Bangladeshi society, this answer may indicate that the adolescent does in fact not know about the 'facts of life'. Another 29 per cent of the boys and 49 per cent of the girls are able to explain that fatherhood or motherhood may follow after a couple has had intercourse ('*shohabas*'). It should be noted in this respect that an answer such as 'having sex' (*'milon'* or *'junamilon'*) was probably too explicit to mention by many of the adolescents. Terms such as 'living together' or 'cohabiting' (*'malamasha'* or *'shamir shathe thakle'*) are often used to mean having sex. It remains unclear whether or not an adolescent who used these terms means in fact 'having sex'. In general, Bangladeshi people try to avoid using such words and prefer to express themselves in what are generally considered 'good words' (i.e. socially acceptable words), such as 'keeping company'[60]. Trying to gain a proper understanding of adolescents' knowledge about human procreation and the reproductive system is difficult. What we learned for instance from the in-depth interviews is that even if adolescents say that they know about pregnancy, there may be a lot of related questions which remain unresolved:

[60] If the adolescent gave an answer such as 'after marriage' the interviewer tried to learn more about the respondent's knowledge by probing. For instance, the interviewer would then ask: "Imagine a married couple. The man leaves for Saudi Arabia to work there for five years. The couple remains married. Can the couple have children in this situation?" If the respondent replied to this question in the negative the interviewer proceeded with asking why not. If the respondent replied that a pregnancy is not possible in these circumstances because husband and wife do not sleep together or cannot have sex or intercourse, this explanation (i.e. 'living together', 'sleeping together' or 'having sex or intercourse') was considered the answer.

Girl, 13 years: *If a husband and wife live together, the woman will get pregnant. A pregnancy continues for 10 months and 10 days. When the woman feels unwell, she goes to the doctor. The doctor examines her and when he confirms the pregnancy, the woman should start counting the pregnancy period from that day onwards. My grandmother told me about it.* ***I would like to know more about how a child is born***.

Girl, 16 years: *A woman gets pregnant if she has sexual contact with a man. The baby stays in the belly for 10 months. Months will be counted from the closing month of menstruation onwards. I learned this from my bandubi (friends).* ***I think their information is correct, but still I would like to know more about how to calculate the expected date of delivery***.

Boy, 15 years: *A man becomes a father if he has had sex with his wife after marriage. A woman gets pregnant if she has sex with her husband after marriage. A full-term pregnancy lasts for 10 months and 10 days. Friends told me so and I was also informed by the moulavi (religious leader). Although I think this information is correct, I do have a few questions. Firstly****, I would like to know how a baby can stay alive in a woman's belly: where does the baby stay and how does it stay alive in there?*** *Secondly,* ***I would like to know how a baby is born***. *Finally,* ***I don't know after how many days a woman gets pregnant after she has had sex with her husband. And why do women always seem to get pregnant after they have been married for about three to four years?***

Boy, 15 years: *A man will be a father after he has had sex with his wife. She will get pregnant then. A full-term pregnancy lasts for 10 months and 10 days. I know this because I overheard some women in the bari when they were talking about this. Also my friends told me so****. I think this information is correct, but I still have some questions about it: why do pregnancies differ in duration?*** *Some say they last for 9 months and some say they last for 10 months.* ***Why are not all pregnancy durations alike****?*

It should be noted that the notion that a pregnancy lasts for 10 months and 10 days is probably related to the fact that people may count a pregnancy in lunar months. The questions as brought forward by the adolescents reveal that despite a superficial *awareness* about reproduction, *factual knowledge* seems low among adolescents. The in-depth interviews underscore that the adolescents interviewed are very *eager* to learn more about reproduction. Such eagerness was also observed in Chapter 4 with regard to learning in general, while analysing data on educational attainment and ambitions.

Apart from factual knowledge, adolescents indicated that they hardly have friends of the opposite sex, let alone sexual experience. From the follow-up survey we learned that the number of friends of the same sex is on average 4.6 for adolescent boys and 3.3 for adolescent girls. Only 29 boys and 15 girls admitted currently having one or more friends of the opposite sex. We did not ask further about whether or not the friendship with a person of the opposite sex had a romantic character. In the in-depth interviews, only very few boys and girls told us that they had (voluntary[61]) 'sexual experience' of which the (perceived) definition seems to be ambiguous:

[61] During the course of the fieldwork, some of the adolescent girls enrolled in our study reported about involuntary sexual experiences among which include incest.

> *Boy, 16 years*: *I* ***do not have any sexual experience****, but I have a girlfriend. We are very close and I have* ***kissed*** *her.*

> *Boy, 15 years*: *I have a girlfriend and our relationship is very good.* ***I also have sexual experience as I have kissed her****.*

Premarital sex is strongly discouraged within the Bangladeshi society, particularly for girls, according to both the adolescent girl as well as a mother and father (see below). Their objections do not only relate to religion and perceived associated reproductive health risks but are also prompted by envisaged difficulties to matchmake the girl's future marriage.

> Girl, 16 years: *Sex outside marriage is bad. Allah has announced that* ***when a girl has sex with another man this is kabira gunah*** *(something that is not excusable).*

> Mother, 34 years: ***Sex before marriage is bad. It destroys the girl's parents' honour****. People will talk about* ***the girl's bad reputation****, say that she has been involved in immoral activities with boys, and it will be problematic to arrange her marriage in the future.* ***The reputation of girls is more easily damaged than that of boys in our society****.*

> Father, 44 years: *Sex before marriage is very bad. Still people do it because they are driven by youth but it is not a good act. It is bad both from a social and religious point of view.* ***It is also bad for health****. One may get infected by diseases like syphilis or gonorrhoea. With respect to social acceptance,* ***girls are being treated worse as compared to boys if they have sex before marriage****. In our society sex before marriage is socially unacceptable. It will be very difficult to arrange such a girl's marriage.*

Likelihood of getting pregnant

Another way of learning about the *accuracy* of *sexual knowledge* is by asking whether a girl or woman can get pregnant the first time she has sexual intercourse, which is in fact the case, given the fact that the girl has experienced menarche. As it would not be culturally appropriate to talk to *premenarcheal* girls or boys about the sexual act so explicitly, this question is addressed to *postmenarcheal* girls only (n=86). Premenarcheal girls were considered 'too ignorant' and it was advised not to interview boys about pregnancy because it 'would trigger bad thoughts' (see also section 3.7.6).

No less than 70 per cent of the *postmenarcheal* girls confirmed the statement that a girl can indeed get pregnant the first time she has sexual intercourse. To the question what the most likely time of the month is that a girl or woman can conceive, 55 per cent of the interviewed girls answered that they did not know. About one-fifth (21 per cent) believes that the greatest likelihood of becoming pregnant is one week before or after the menstrual period. Another 15 per cent of the girls thinks that a girl is most likely to conceive during the menstrual period itself. The 'correct' answer, i.e. the answer which is in accordance with accepted bodies of knowledge and which is also applied in other (reproductive health) surveys (see, for instance, CDC 2001, p. 185), is approximately two weeks before or after the menstrual period. This correct answer was given by only 6 per cent of the girls. Also, 4 per cent of the girls does not distinguish the different chances of conception throughout the month.

7.4.2 Perceptions about timing of marriage and childbearing

As explicated in section 2.5, adolescent marriage is far from uncommon in Bangladesh (subsection 2.5.1) and adolescent childbearing may pose serious problems for the young mother-to-be as well as her child, particularly if she is malnourished and her gynaecological age is young (subsection 2.5.2). However, among our sample of 12 to 16-year-old adolescents only a few were married and/or pregnant (see subsection 3.7.6). In the follow-up survey we asked the adolescents about their future aspirations concerning their marital and reproductive health career. Virtually all interviewed adolescents (n=485) picture their future life with a spouse (99 per cent irrespective of sex) and children by their side (97 per cent of the boys and 98 per cent of the girls). All but 5 per cent of the adolescent boys already knows how many children they would like to have in the future, and there is only a minor difference between the two sexes: girls prefer to have on average 2.5 children, whereas boys would like to have 2.7 children. There is a strong wish to have at least one son and a daughter (65 per cent of all adolescents). A daughter is indeed welcomed only if she has a brother already. Relatively few adolescents think that larger families, i.e. families consisting of three children (27 per cent) or more than three children (15 per cent), would be best for Bangladesh.

We asked the adolescents what they perceive as the ‘best’ ages for girls to get married and become a mother and for boys to get married and become a father. These questions appeared to be highly sensitive, not so much because of the number of children *per se* but rather because inquiring about childbearing is associated with sex. One 13-year-old boy for instance, became very shy and replied *“At my age, I cannot give you an answer to this question”*. Another adolescent boy, who had been interviewed earlier, interrupted the interview of his 13-year-old sister, saying that *“She is too young and will not answer these kinds of questions”*. He did not allow us to finish the interview with his sister.

However, as illustrated by the following excerpts from interviews with an adolescent boy, a father and a *ghatok* (matchmaker), age is one of the many factors that people take into account while considering marriage:

> Boy, 16 years: *My parents will decide upon my marriage. They will arrange my marriage when I have grown up, have a job and earn money. In many places they will search for a suitable bride. Whether she is suitable depends on whether she is pretty, the kind of house she lives in, her character and her social status. Other family members such as uncles will also be involved in the matchmaking process. After they have selected a girl, I shall be sent over to see her and if I agree then the match will be finalised* ***. I will look at her age, her education, her parents’ social status, her character and whether she displays good behaviour etc. But she should also be beautiful and look smart.*** *When both sides agree, a marriage date will be mutually chosen. I have no say in this.*

Father, 44 years: *Regarding my son's marriage, the following factors are of importance. Firstly* ***the bride's figure****. Is she* ***short or tall****? And how are her* ***skin colour and her hair****? Secondly, the* ***economic position of her father****, and that of her brothers and sisters, as well as their* ***social position****. I ask myself whether I will be able to maintain my social position if we take her as my son's wife. Thirdly I'll look at her age. Is her age appropriate for marriage and will it be compatible with my son's age? Finally, she should be* ***educated*** *and her brothers and sisters also, more or less. For my daughter's marriage we will look at* ***the groom's income and his education****. We ask ourselves "How is he?" This will account for 80 per cent of the decision to select him to marry her. The rest of the decision will be based on the position of the groom's guardians (parents).*

Ghatok, 68 years: *Guardians in the broadest sense of the word, let's say parents, elder brothers, uncles and grandfathers come to me and ask me to arrange a marriage for their son or daughter. I start with collecting information about the people who come to me with such a request. I want to know for instance* ***where their house is located, what the occupation of the adolescent's father is, what the occupation of the boy or girl is, how much money the boy earns, how many brothers and sisters he/she has, the occupations of the brothers and sisters, land property of the family, educational level of the other family members, what type of boy or girl they would like for their daughter or son respectively, whether they have any expectations about the amount of dowry, and if so, how much taka etc.***

Secondly, with all this in mind, I go through a mental list of boys and girls whom I know and see whether there is anyone suitable. The match that I try to make is particularly based on ***the background and economic status*** *of the two families. If a match is feasible, I inform the guardians of both sides. They always want to see the proposed bride or groom and their house. So I arrange an informal or formal meeting. When the guardians of both sides are positive about the bride and groom as well as their house, the dowry negotiations can start. I lead these discussions, which may last for one day or four to five months. If the respective guardians fail to come to an agreement about the dowry, the matchmaking process will be broken off, but I always try to direct the negotiations in such a way that an agreement is reached and a match results. All in all, the whole matchmaking process may take a few days or more than one year. One can never tell how much time it will take for the ghatok.*

In general, guardians from my own or surrounding villages come to me, although sometimes also a potential groom comes to me directly. I also visit families in order to discuss a possible marriage with them. Thus, the factors that are important with regard to the matched marriage are first of ***all how the bride or groom looks like: skin colour, appearance, body height, educational qualifications, character.*** *Secondly the potential bride or* ***groom's father's occupation is important****, as well as* ***income, social position, house, land property, the number of brothers and sisters, their age, whether they say prayers and read the Koran, their relatives' positions, the amount of valuables that will be provided as dowry, how the marriage will be registered, how well the bride does household work, how well she cooks and how many guests will come with the groom****.*

What stands out in the analyses of follow-up data is the apparent agreement between adolescent boys and girls when it comes to the preferred timing of marriage and childbearing. Table 7.7 shows the group mean (as well as the minimum and maximum) age that adolescent boys and girls perceive as being the 'best' age to get married and to become a parent.

Table 7.7 Adolescent boys' and girls' perceptions about the 'best' age for girls and boys to get married and to become a parent, Matlab 2001

Sex	Best age (in years)	Marriage for girls	Marriage for boys	Parenthood for girls	Parenthood for boys
Boys	Mean	19	25	22	28
	Minimum	12	15	14	19
	Maximum	30	40	30	40
	n	245	248	226	232
Girls	Mean	19	25	22	27
	Minimum	12	17	15	19
	Maximum	26	35	35	40
	n	216	213	213	204

The age that adolescents consider to be the 'best age' to get married is similar for boys and girls. The mean 'best age' for marriage for a girl and a boy in Bangladesh according to the adolescents in our sample is 19 and 25 years respectively. Adolescents are also rather consistent regarding the question on the 'best age' for parenthood. On average boys consider the 'best age' for fatherhood to be 28 years. This figure is in line with current data on age at first birth for men in Matlab (ICDDR,B 2001). Among adolescent girls, the age of 22 years was considered on average as the 'best age' to become a mother. Also boys regard this age as the most suitable age to start motherhood for girls. Slightly over one-third (35 per cent) of the adolescents thinks a girl should become a mother at or before the age of 20 (not shown).

Age differences at marriage between the spouses in Bangladesh may exceed 10 years (subsection 2.5.1). However, views about age differences may differ between adolescents and parents, as illustrated below:

> Girl, 15 years (married): *I got married when I was 11 years. My grandmother arranged my marriage. They told me that I was going to marry on the wedding day itself. I did not agree with the marriage because* ***I had feelings for my cousin****. I had always hoped that my future husband would be good looking, display good behaviour and to be engaged in the services sector.* ***My husband is 16 years older. But I never think about this age difference****. I did not have any sexual experience and I was afraid seeing my husband for the first time on our wedding night.*

> Mother, 34 years: *A marriage that takes place after a love affair or a friendship is not good. People will consider the couple to be immoral and they have a bad reputation. Marriage by choice of the parents is good because if anything, for example problems, happens in conjugal life, the parents can solve it.* ***I am 15 years younger than my husband. I am always aware about this, particularly that he will probably die before me****.*

> Father, 36 years: *I felt very lucky and happy after marriage. Allah has put people on this earth to marry and to have a family life. I loved my wife directly after our marriage. We got married because it was the choice of my parents. I was not introduced to her before marriage. Though, I prefer marriages after a relationship, because if the boy and the girl have the same ideas and similar expectations, no problems will arise after they get married.* ***I am 7 years older than my wife. It is good if the husband is older than his wife, because a woman does not understand as much as her husband****. So the man can help her understand things.* ***This is the rule****.*

Contrary to the idea that within the cultural setting of Bangladesh, menarche announces the start of the reproductive career and "readiness for marriage" (Riley et al. 1993, p. 52), the in-depth interviews revealed that menarche is not necessarily perceived as 'readiness' for (adolescent) marriage:

> Girl 13 years: *My first menstruation occurred when I was 11 years, but that does not mean I was ready for marriage. According to me, a girl is ready for marriage when she is 25 or 26 years old*.

> Girl, 16 years: *Menarche does not mean that a girl is ready for marriage. She will be ready when she has grown up and is 18 or 19 years old. Marriage at the age of 30 to 35 years is called late marriage and marriage at the age of 12 to 13 years is considered early marriage*.

It should be kept in mind that it is generally not the adolescents themselves who decide about the timing of marriage (and childbirth) but their parents. The views of the parents may differ from those of their adolescent children:

> Mother, 35 years: *We do not accept our children's opinion about the proposed marriage because we believe* ***that the parents' choice is also the choice of their children****.*

> Mother, 34 years: *Marriages that occur after a relationship are not good because the future in-laws will not like it****. Parents or guardians should always arrange their children's marriages, because then they can solve any marital problems if they should occur****.*

> Father, 36 years: *In a rural* ***area, a girl's marriage should be arranged when she is about 20 years old****. She is no longer nice to look at when she is older than 20 years. Marriage at the age of 12 to 15 years is early. It will be* ***harmful*** *for a girl if she marries this early, because she has* ***no idea about family life*** *yet. Besides, her body will be* ***damaged by childbirth*** *and she may catch many* ***diseases*** *then*.

> Father, 44 years: ***Marriage at the age of 25 years is late*** *because by then a girl's face has changed and her body may be tainted. It will be difficult to arrange her marriage if youth is over*.

The fathers are aware that problems may occur if a girl bears a child at an 'early age'. We also talked with mothers and fathers about their own experiences with early marriage and childbearing in order to learn whether this affects or has affected their views on the timing of (the future) marriage of their adolescent daughter:

Mother, 34 years: ***I got married at the age of 12 years and my first child was born 3 years later. I did not face any problems during the delivery. Therefore we also married off our daughter early****. She also had her first child at an early age, and* ***she also did not face any problems****. But I know that many problems may arise if a girl delivers at an early age. The young mother may catch many diseases, her 'body feels bad' and also her child may have problems*.

Mother, 34 years: ***I got married when I was 16 years old. I got pregnant after 1.5 years of marriage. When the contractions started it took two more days of labour before I finally delivered. Because of this experience I shall not marry off my daughter until she is 18 years old****. A mother may be weak during delivery because of her young age. Mother and child may die. I expect that my daughter will not face any delivery problems if her marriage is arranged when she is 18 years old*.

Mother, 34 years: ***I got my first menstruation when I was 16 years old and I also got married in the same year. My first child was born after one year of marriage****. At the time I was about to deliver, I woke up with pain in the morning and I delivered at night.* ***The delivery was very difficult****. Force was applied to help the baby out.* ***I therefore do not agree about arranging my daughter's marriage at an early age****. A mother and her child may die if problems occur during delivery because of the mother's young age. If I do not marry off my daughter quickly, she does not need to face these problems*.

Father, 44 years: *I married at the right age but my wife was very young.* ***She faced many problems during her pregnancy****. She delivered in our bari. She suffered from delivery pains. During the delivery her body was weak and the delivery pains continued for a long time.* ***My wife was not ready physically for a pregnancy****. In these situations, the baby may be small and the mother may die.* ***Knowing this, I wonder about the age at which my daughter will get married. I will not marry my daughter off at a tender age***.

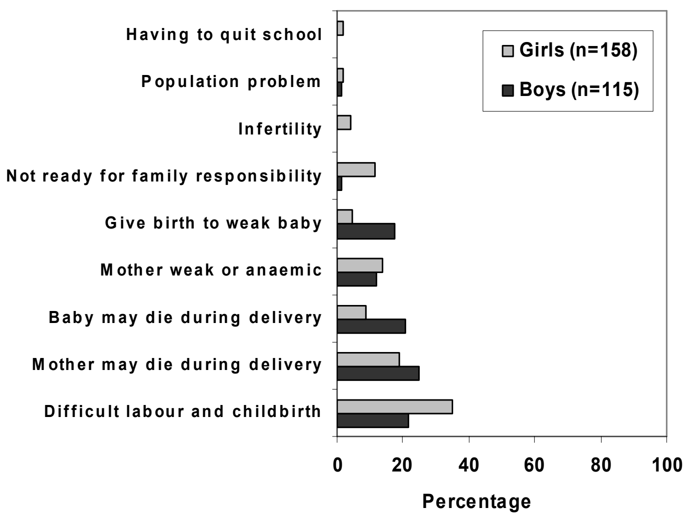
Father, 36 years: ***My wife married me when she was 15 ye****ars. No one should get married at this young age because a girl is* ***mentally not that developed*** *yet.* ***My first child was born after 3 years of marriage****. My wife did not face any problems during the delivery but I shall not arrange my daughter's marriage at a young age. I know that if a girl marries at an early age her body is not ready for a pregnancy, and a* ***delivery may destroy her body****. Many problems may arise during delivery and* ***sometimes an operation is needed to deliver the child****. Mother and child may die because of difficulties at delivery.* ***I shall not arrange my daughter's marriage until she is fully matured***.

On the basis of these excerpts from interviews it seems that the personal experiences of mothers and fathers play an important role with regard to the timing of their adolescent daughter's marriage. For only one mother her own positive experience with early marriage and childbearing was reason enough to marry off her daughter at an early age. The other mothers and fathers are very conscious about the timing of marriage of their daughter because of negative experiences of their own (or of their wife) or because they have knowledge about potential problems that may have occurred. Some parents await specific 'cut-off' points based on age ('18 years', older than the 'tender age') or perceived maturity ('fully matured') that their daughter must reach before they marry her off.

It should be noted in this respect that one *ghatok* told us that early marriage used to be seen as a potential risk of reproductive health because the immature girl could become pregnant, but that this idea is recently a subject of discussion because of the increasing availability of contraceptives. Given that nowadays early childbearing can be prevented by means of contraception, nothing stands in the way to marry girls off at an early age.

In the follow-up survey, we also asked the adolescent girls and boys whether they knew of any problems that may happen if a girl gets pregnant at an early age, which was defined in this particular question for the sake of clarity as an age of 18 years or younger (Figure 7.3).

Figure 7.3: Problems adolescents associate with adolescent childbearing by sex, Matlab 2001 (%)



There are more girls than boys who are aware of at least one potential risk related to early childbearing: 45 per cent of the adolescent boys against 72 per cent of the adolescent girls. The most frequently reported problems among both adolescent boys and adolescent girls are the possibility of difficult labour and childbirth because of the mother's age (22 per cent of the boys; 35 per cent of the girls), and the fact that the young mother may die due to complicated labour and delivery (25 per cent of the boys; 19 per cent of the girls). A related potential consequence that adolescents are aware of is weakness and anaemia of the mother (12 per cent of the boys; 14 per cent of the girls). The possible detrimental outcomes for the baby are less often mentioned, although particularly boys note that the baby may die because of obstructive labour (21 per cent of the boys; 9 per cent of the girls). Some adolescents, albeit only girls (4 per cent) also know of infertility as a result of permanent reproductive damage (for instance, complicated labour followed by infections). Finally, some adolescents, mainly girls, associate early childbearing with not being ready to bear the responsibility for raising a family (2 per cent of the boys; 12 per cent of the girls).

7.4.3 Knowledge and perceptions about contraception

Related to human reproduction are knowledge and perceptions about contraception. We asked the adolescents whether they have ever heard about methods or practices to prevent or delay having children. Again, this appeared to be a highly sensitive topic to be discussed between parents and children, as formulated by one father:

> Father, 44 years: *Regarding sexual matters, I have been informed by many sources: friends, health workers, and different kinds of media such as radio and television.* ***I never discuss contraception with my children. It is not possible to discuss this with them because such a topic is not discussable.*** *What I know about contraception is that those who do not want to become pregnant can make use of several kinds of contraceptive methods. Contraception is essential. For instance, in our family it is not possible to upkeep four or five children and to pay for their education. Although contraception is not in line with Islam it needs to be used.*

In the follow-up survey, we collected data on adolescents' contraceptive knowledge in a two-stage way. We first posed the question whether adolescents had ever heard about contraceptives. The answers revealed a striking difference between adolescent boys and girls: only 34 per cent of the adolescent boys answered in the positive against 68 per cent of the adolescent girls (total n=485).

None of the (unmarried) adolescents had ever used a contraceptive method, but again adolescents display an eagerness to learn about it, though boys and girls may prefer different sources of information:

> Girl, 16 years: *I have talked about contraception with my brother's wife and my girlfriends. Contraception after marriage is good because it helps to limit the number of children and keeps the family small. It is however not in line with Islam.* ***I prefer to be informed about contraception by my brother's wife****.*

> Boy, 15 years: *I have never talked about contraception with anyone.* ***When I need information about this subject I want to be informed by a doctor****.*

Some of the *married* girls (of which there were 7 in our sample) applied modern or traditional ways of family planning. One girl particularly uses contraception because of her young age:

> Girl, 16 years (married): *The age difference between me and my husband is 16 years. I had no sexual experience before marriage. I was afraid on the wedding night.* ***I use contraception because I am an under-aged girl*** *and studying, so I use contraception in order to avoid a pregnancy.*

> Girl, 16 years (married): *I do not use any contraception, but* ***I follow the day****: I do not have sexual contact with my husband up to 20 days from the starting day of menstruation.*

Among the group of adolescents who heard about contraception, we inquired - in a second step - whether the adolescents considered themselves as being informed about contraceptives. No less than 89 per cent of the adolescents stated that they were informed (n=240). As outlined in Table 7.8 the three main sources of information for adolescent boys (n=66) were friends (49 per cent), the media, i.e. newspapers, television and radio (30 per cent), and a doctor or a health worker (9 per cent). Among adolescent girls (n=148) the range of sources of information is again broader, with the most important groups being sisters or sisters-in law (29 per cent), friends (21 per cent) and aunt, cousin or niece (20 per cent).

Table 7.8 Information sources about contraception of adolescent boys and girls, Matlab 2001 (%)

Sources	Boys (%)	Girls (%)	Total (%)
Friend	49	21	31
Sister or sister-in-law	8	29	23
Newspaper, radio or TV	30	9	15
Aunt, cousin or niece	2	20	14
Doctor, health worker or midwife	9	10	9
Mother	0	5	3
Neighbour	2	3	3
Grandmother	0	3	2
n	100 (n=66)	100 (n=148)	100 (n=214)

The role of health workers may be smaller than expected given that family planning services are among the most important of ICDDR,B. A possible reason is the fact that the study has been undertaken in the so-called *Comparison* area and not in the *MCH-FP* area of Matlab (see section 3.5). Moreover, services and information provided by, for instance, the youth counsellor may be more easily accessible for *married* as compared to *unmarried* adolescent girls:

> Female youth counsellor working for a Family Welfare Centre (FWC), 30 years: *About 10 to 12 adolescents come to me at this centre every month. I see only girls. Adolescent boys do come to our centre but are not handled by me. They are served by the Sub-Assistant Community Medical Officer.* ***Most adolescent girls that come to our centre are married.*** *They come to the centre for general health facilities, family planning, menstrual regulation (MR) treatments, antenatal and postnatal care, and childcare in general. Boys also come here for general health facilities and for health advice. We serve as a satellite clinic. Our centre provides treatments free of charge.* ***There is a difference between married and non-married girls who come to our centre****. Girls who are not married usually come for the general health facilities or for a MR treatment, whereas married girls generally come for Family Planning, MR treatments, ANC, PNC and for counselling. We do not carry out abortions in this FWV centre, but refer girls to the thana Health Complex or to a private clinic in a district town.* ***An abortion costs about 3,000 to 4,000 taka but is more expensive if the girl is not married****. Sometimes abortions are carried out by a person from the girl's bari who is not qualified. As a result, the girl may face many problems. She may become weak due to heavy bleeding and may even die. This all happens because of the lack of experience of the person who carried out the abortion.*

Also from the in-depth interviews we learned that mothers (and fathers) hardly play a role in this respect, though they attach great importance to contraception. The interviews also reveal that different religious opinions are held with regard to the use of contraception:

Mother, 33 years: *I* ***do not talk to my children about contraception****. Contraception after marriage is* ***good*** *because it is good for the health status of the mother and it keeps the family small and happy. I do not know whether contraception is in line with Islam*.

Mother, 34 years: *I never discuss contraception with my children.* ***Contraception after marriage is good because it delays childbearing and enables us to have only a few children****. Family life will be happy and peaceful. However, contraceptive methods are* ***against Islam****. But I am currently using contraception because I do not want more children. We took this decision together, my husband and me.*

Father, 36 years: *Contraception is in line with Islam* ***because Islam says: make family small and take care of your child properly*****.**

Nevertheless, this apparent acceptance does not seem to open doors for discussion on contraception between the generations. According to some mothers, talking about this topic with their children would mean disclosing a '*secret*' or is perceived as '*shameful*':

Mother, 34 years*: I do not talk to my children about contraception because I consider this a* ***secret****.*

Mother, 34 years*: I do not talk to my children about contraception as this would be* ***shameful****.*

To those adolescents who said that they were indeed informed about contraception (n=240) we continued by asking whether they were able to explain the working of a certain contraceptive method and whether they knew where to access it. The results are shown in Table 7.9. It should be noted that for each method we selected two main characteristics about its working that needed to be mentioned by the adolescent before he/she is considered to know about the method. If the adolescent mentioned one of the two selected main characteristics about how the method works, the answer was rated as 'partial knowledge'. Similarly, an answer, which contained none of the two selected main characteristics about the working of the method, was rated as 'no knowledge'. With regard to the contraceptive pill, for instance, we rated an answer as 'knowledge' if the adolescent indicated that he/she knew that the pill worked with hormones and that the pill should be taken every day by the girl or woman in order to make it effective.

The pill is the most used contraceptive method in Bangladesh among contraception users (both adolescents as well as adults) (Islam and Mahmud 1995, p. 26), but in Matlab injectables are mostly used among married women (ICDDR,B 2002a, p. 55). The working of the pill is (partly) known to 53 per cent of the boys and 76 percent of the girls. They were able to mention that it is a method that involves daily pill intake by the woman. None of the adolescents knew that it involves hormonal manipulation.

A relatively high proportion of boys and girls - respectively 27 and 9 per cent - gave an insufficient explanation about how the pill worked (for instance, that it should be taken only once). In addition, we asked the adolescents to indicate how reliable they think the pill is as a contraceptive method (not shown). Over one-third of the adolescents, 35 per cent, indicated that they did not know the answer to this question.

A similar proportion (35 per cent) rated the reliability of the pill as 'completely or almost sure' (n=240).

Knowledge about the IUD (for instance, Copper T or plastic coil) and the diaphragm is virtually absent, irrespective of the adolescents' sex. About one-third of the adolescents - 39 per cent of the boys and 33 per cent of the girls - knows that a contraceptive injection is for females, whereas 10 per cent of the girls knows that a contraceptive injection needs to be repeated after several months.

Table 7.9 Adolescents' knowledge about contraceptives and their perceptions about their accessibility by sex, Matlab 2001 (%)

Method	Knowledge of the method			Knows where to access it		
	Boys (%)	Girls (%)	Total (%)	Boys (%)	Girls (%)	Total (%)
Pill				97	90	93
Knowledge	1	1	1			
Partial knowledge	53	76	68			
No knowledge	27	9	15			
Not reported	19	14	16			
IUD				2	2	2
Knowledge	0	0	0			
Partial knowledge	0	1	0			
No knowledge	1	1	1			
Not reported	99	98	99			
Injection				61	74	70
Knowledge	8	28	21			
Partial knowledge	39	43	41			
No knowledge	2	7	5			
Not reported	51	22	33			
Diaphragm				3	1	2
Knowledge	0	1	1			
Partial knowledge	0	1	1			
No knowledge	1	0	1			
Not reported	99	98	97			
Condom				65	20	37
Knowledge	8	10	9			
Partial knowledge	16	4	8			
No knowledge	14	6	9			
Not reported	62	80	74			
Tubes implanted				5	1	2
No knowledge	1	0	0			
Not reported	99	100	100			
Tubectomy				43	76	64
Knowledge	22	58	44			
Partial knowledge	10	22	18			
No knowledge	1	2	2			
Not reported	67	18	36			
Vasectomy				32	13	10
Knowledge	6	9	8			
Partial knowledge	2	3	3			
No knowledge	1	1	1			
Not reported	91	87	88			
n	100 (n=88)	100 (n=152)	100 (n=240)	n=88	n=152	n=240

There is more knowledge about condoms, although the percentages are low: respectively 8 and 10 per cent of the boys and girls know how a condom works (that it is a method for males, to be put on every time before intercourse). Similar proportions, 14 and 6 per cent of the boys and girls respectively, come up with insufficient explanations about the working of the condom (for instance, that it needs to be blown up and hung in the room where the couple is having sex). Additionally, 62 and 80 per cent of the boys and girls were not able to report about how a condom works. It should be noted that adolescents, possibly girls more than boys, may have felt too shy to discuss this method.

With regard to the perceived accessibility of the respective contraceptive methods, Table 7.9 reveals that despite the adolescents' overall low level of knowledge about contraception they generally know where to go in order to obtain the contraceptive pill, and to a lesser extent, a contraceptive injection, condom and female sterilisation or tubectomy. Condoms are in general on sale everywhere, thus easily available, and when one is walking through the villages, children can be seen playing with them as little balloon-like toys.

Perceived costs
Contraception may also be beyond the reach of the adolescents because of (perceived) costs. We asked them to estimate the price of a particular type of contraception and contrasted this with the average estimations of the interviewers (Table 7.10).

Table 7.10 **Average estimates of prices of contraceptives (in *taka*) among the adolescent boys and girls and interviewers, Matlab 2001**

	Prices as estimated by the adolescents				Prices as estimated by the
Method	price by boys	n	price by girls	n	interiewers
Pill	7	38	3	117	Up to 40 *taka* for a one-month packet
IUD	-	-	-	<5	Free in hospitals but limitedly available
Injection	34	7	6	76	Free in hospitals
Diaphragm	-	<5	-	<5	Not available in Matlab
Condom	1	44	4	21	0.5 to 3 *taka* per piece
Tubes	-	-	-	<5	Free in hospitals
Tubectomy	-	-	243	70	Free in hospitals
Vasectomy	-	-	125	12	Free in hospitals

The estimations of the interviewers were based on prices of the respective contraceptives in local shops, pharmacies and hospitals. In Matlab, contraceptive pills with brand names such as *Shukhi*, *Nordette 28*, *Obstate* or *Ovacon* can be obtained in a pharmacy, from health workers, or directly from doctors or midwifes affiliated to a hospital, satellite clinic or one of the FWCs (Family Welfare Centres). The pill can be obtained freely from, for instance, health workers or bought for up to 40 *taka* per one-month packet depending on the brand, which is higher than the price estimated by the adolescents.

For an *IUD* a woman needs to go to a hospital or a FWC where it is inserted free of charge, although it is limited in supply. That this is hardly known by the adolescents should be seen in light of the absence of knowledge about this method in the first place.

Contraceptive injections (for instance, *Depo provera*) are given to women in hospitals, satellite clinics, FWCs or at home by a health worker. A few boys were able to give an estimation of the price of this method but their estimation was far too high (on average 34 *taka*), whereas the estimated average price among girls is 6 *taka*. Both amounts are incorrect since injections are available free of charge in hospitals. The latter was common knowledge among 67 per cent of the adolescents in our sample.

Condoms (for instance, *Durex* or local, and less expensive, brands such as *Sensation*, *Panther* or *Raja*) can be obtained at many places. Of course they are provided by hospitals, satellite clinics, FWCs and health workers but they can also be bought at a pharmacy or even a grocery shop for about 0.5 to 3 *taka* per piece (local brands). In Bangladesh, it is highly unlikely that a girl or woman will ask for condoms either in a hospital or a shop. In contrast to boys, who correctly estimate the average price per condom according to the market price, girls on average gave too high an estimation.

In sum, the results as described in this section reveal that although awareness of contraception seems high among adolescents, *understanding* of most contraceptive methods, as indexed by explaining the working of the methods, is in fact relatively low. Generally, adolescent girls seem to be better informed about how contraceptive methods work as compared to their male counterparts. Though the majority of the adolescents do know where to access some contraceptives, such as the pill, contraceptive injection, condom or tubectomy, they tend to over-estimate some prices as several contraceptive methods are available free of charge in hospitals.

7.4.4 Awareness of HIV/AIDS

As noted in Chapter 2 (section 2.5), the HIV/AIDS epidemic seems to spread at a slow pace in Bangladesh and HIV/AIDS incidence is concentrated within high-risk sub-groups, among which include people under 25 years of age (Gubhaju 2002; FHI 2001; FHI 2003). We studied therefore the level of the adolescents' knowledge about HIV/AIDS and prevention.

Among the adolescent study population 47 per cent of the boys (n=260) and 27 per cent of the girls (n=242) have heard about HIV/AIDS. These figures may considered high in view of the fact that other STDs (sexually transmitted diseases) such as syphilis and gonorrhoea are unknown to virtually all adolescents: only 4 and 1 per cent of the boys and girls respectively have heard about syphilis and gonorrhoea.We further asked the adolescents who were aware of one or more of the aforementioned STDs (including HIV/AIDS), whether they think a person can be infected by syphilis, gonorrhoea or the HIV virus without having any physical signs or symptoms of the disease. A high proportion of the adolescents (66 and 40 per cent of the boys and girls, respectively) indicated hat they did not know the answer to this question. Slightly over one-quarter (27 per cent) of the boys (n=124) and over half (54 per cent) of the girls (n=65) are aware of the potential risk of being infected in the absence of physical signs.

We inquired - in an open question - among the adolescents (the aforementioned 124 boys and 65 girls) about factors or behaviours which would in their view increase the risk of becoming infected with an STD including HIV/AIDS. Of the interviewed adolescents, 41 per cent of the boys and 51 per cent of the girls replied that they did not know of any risk-inducing factor or behaviour (not shown). The remaining group of adolescents ascribes an infection to a broad number of factors or behaviours that are known to increase the risk of getting infected. In Table 7.11 the perceived modes of transmission are listed (absolute numbers by sex, and adolescents could mention more than one factor).

Table 7.11 Adolescent boys' and girls' views* about modes of HIV/AIDS transmission, Matlab 2001

Perceived modes of HIV/AIDS transmission	Boys	Girls	Total
Sharing needles	40	17	57
Having extra-marital sex and not using a condom	35	13	48
Having many sexual partners and not using a condom	22	9	31
Receiving an unsafe, such as non-screened, blood transfusion	22	8	30
Transmission from mother to foetus during pregnancy	15	6	21
Sharing objects with a person who is infected	5	2	7
By bad spirit or the evil eye	1	4	5
Through breast-feeding	5	0	5
Having a homosexual relationship and not using a condom	2	2	4
Going to a brothel and not using a condom	0	3	3
Wearing dirty clothes	0	2	2
Have sex with someone with a different blood group	1	1	2
Shaking hands with an infected person	0	1	1
Kissing an infected person on the mouth	0	1	1
Arsenicum in drinking water	1	0	1
Smoking	1	0	1
Not being vaccinated	1	0	1
From mosquito bites	0	1	1
n	124	65	189

** More than one factor per adolescent possible*

The most frequently mentioned factors are sharing needles, a blood transfusion using non-screened blood, or having unsafe sex, i.e. sex without using a condom, particularly in settings that are potentially more risky such as having sex in a brothel, extramarital sex, or homosexual contact without condoms. In addition, some adolescents mentioned the possible transmission from an infected mother to her foetus during pregnancy and the transmission risks related to breast-feeding. Other presumed risk-increasing factors which were mentioned by the adolescents but for which there is no biomedical evidence that they enhance the likelihood of getting infected with HIV, are the influence of a bad spirit or the evil eye, sharing household utilities with an infected person (and the related belief that infected people should not be touched at all), wearing dirty clothes, having sex with someone with a different blood group, not being vaccinated in childhood, mosquito bites, smoking, and drinking of arsenic contaminated water.

The above results indicate that many adolescents are misinformed or not aware about factors or behaviours which elevate the risk of becoming infected with HIV/AIDS. An example of a well-intentioned advice on the prevention of HIV/AIDS which nevertheless failed to bring over the message effectively because of a different *schema* (see subsection 2.2.1) is illustrated by the story below:

> *One of the adolescent boys told us that one should never eat a black cat because this would cause AIDS. To our question where he had picked up this knowledge, the boy answered that a while ago an information film was televised in which the people were told to be aware about the spread of AIDS. In this film a crucial role was allotted to a black cat. Furthermore, a married couple was featured in the film. They were happy at first but sad and confused in the end. It was not made clear precisely what caused their change of mood, but apparently something 'dark' and 'fearful' had come in between, which was represented by the black cat walking towards the couple. A voice-over explained that AIDS had hit their lives. In the adolescent boy's interpretation the couple had eaten the black cat, as a result of which they apparently had contracted AIDS.*

7.5 Conclusions and discussion

In this chapter, research question 5 (section 1.3) was explored in an effort to establish whether adolescent girls and boys are informed and prepared about the reproductive transitions they face during this stage of their lives and to study reproductive development which becomes increasingly important in more advanced stages of the reproductive career, particularly when marital life begins. Being informed, for instance about the origin of menarche, human procreation or the reliability of the contraceptive pill may be considered as a prerequisite for reproductive health as it may help dispel fear or confusion, and moreover, as a condition for 'informed choice'. In this chapter we combined data collected by means of a survey and in-depth interviews. Coherence to these two types of data was facilitated by analysing them jointly. The analyses presented is guided by *hypothesis 10* which states that adolescent girls and boys are not or insufficiently informed or prepared for menarche and spermarche respectively and reproductive development in general, and that girls are less informed than boys.

We first discussed how adolescent girls and boys perceived the transition of menarche and spermarche respectively. A relatively high proportion of postmenarcheal girls in our sample (64 per cent) reached menarche in fear, indicating low reproductive well-being from a mental-emotional perspective. Underlying this fear may be a lack of preparedness. The girls and boys whom we interviewed in-depth did not have any or they had only little knowledge about the physical origin of menarche and spermarche respectively. The link with reproduction and the will of Allah, as indicated by some mothers (not daughters), seems to bestow a sense of 'religious preordainment' on menarche. The association with sexuality may make it difficult or impossible to discuss menarche between mothers and daughters. The latter corroborates descriptions in subsection 2.4.3, from which we learned that in Bangladesh menarche is both an important event in life as well as a very private matter.

The differences between boys and girls were striking when it came to whether they talked to someone after onset of spermarche and menarche respectively. Having someone to talk to may particularly be important in view of the previous observations of how fear and anxiety accompany reproductive transitions and about the high number of premenarcheal girls that was not informed about their upcoming menarche (65 per cent). The majority of the postspermarcheal boys (65 per cent) kept silent about experiencing spermarche, whereas the rest turned to friends. Postmenarcheal girls were not only much more likely to talk to someone after they had experienced menarche (85 per cent talked to someone), their social circle in this respect also seems much broader, ranging from friends to female family members. The role of mothers is slightly smaller than that of friends, sisters and aunt or cousins of the adolescent girl.

From our analyses we learned that the social significance of reproductive transitions is much greater for girls than it is for boys. The list of daily-life changes for girls due to menarche is substantial and their lives are increasingly confined to the home yard of their families. Also, in line with other observations (for instance Blanchet 1996), the period of adolescence may start earlier than at the moment of reaching menarche, and it may be marked by other (social or mental) characteristics and behaviours (reflected by notions such as being able to *'realise things'* and *'distinguish between good and bad'*). Menstruation is accompanied by feelings of weakness by 44 per cent of the girls. A smaller proportion (14 per cent) mentioned that they experience headaches and moodiness on their menstrual days. In spite of this, menstruation is in general perceived positively because it is considered as a means to restore 'good health' by purging or washing away the 'bad blood'. Moreover, as was the case with menarche, menstruation is welcomed as an identification of womanhood.

A striking finding from the analyses on information about the adolescents' knowledge about human procreation was that although adolescents may say that they are informed (84 per cent of the boys, 71 per cent of the girls) their factual knowledge seems to be lower. In line with this, it appeared that 70 per cent of the *postmenarcheal* girls confirmed the statement that a girl can indeed get pregnant the first time she has sexual intercourse, but that only 6 per cent of them actually knew that a girl or woman is most likely to conceive approximately two weeks before or after the menstrual period. Several questions that some adolescents posed in the in-depth interviews were revealing. These questions display a great eagerness among both adolescent girls as well as boys to learn more about the basic facts related to pregnancy and childbearing.

The 'best' age at which a girl and a boy in Bangladesh should marry according to the adolescents in our sample is 19 and 25 years for girls and boys respectively. On average, the age of 22 years was considered by the adolescents as the 'best' age to become a mother. Slightly over one-third (35 per cent) of the adolescents thinks a girl should become a mother at or before the age of 20. In Matlab, it is the parents who generally decide about the timing of the marriage. In the in-depth interviews some parents revealed that they base their decision on the timing of (the future) marriage of their daughter among others upon their own experiences with early marriage and childbirth. Their negative experiences with early childbearing may result in a later timing of marriage of their daughter.

The proportion of adolescents who had 'ever heard' about contraceptives was relatively low: 34 per cent among the adolescent boys and - twice as high - 68 per cent among the adolescent girls. Of this group the majority (89 per cent) considered themselves to be 'informed'. However detailed analyses of questions about knowledge of the working of respective methods of contraception showed that their factual knowledge is small. The working of the contraceptive pill for instance - the most commonly used method in Bangladesh among those who have ever used contraception - is only partly known by 68 per cent (they know it should be taken every day by a woman, but do not know it is a hormonal method). Finally, almost half of the adolescents (47 per cent) have heard about HIV/AIDS. However, including in the reported list of perceived modes of transmission are factors that are not sound from a biological point of view, on the basis of which one may conclude that education for adolescents about this topic is required. A way needs to be found which answers the need for clarity while ensuring that cultural norms about sexual propriety are not contravened.

In sum, mental reproductive health status of adolescent girls and boys as indicated by reproductive knowledge and perceptions (including emotions) seems to be insufficient due to a lack of preparedness (for instance, for menarche) and lack of information (for instance, on contraception). Contrary to the hypothesis, girls seem better informed than boys. Adolescents display great eagerness to learn more about (their) reproductive health status and development. It is important to keep in mind, for instance when drawing up educational campaigns for adolescents, that it is not only the differences in knowledge between boys and girls but also the different (preferred) sources of information about reproductive matters that need to be addressed.

8 Conclusions and discussion

8.1 Introduction

We have endeavoured to study the reproductive health status of adolescents in Matlab, rural Bangladesh, and to assess the relative contribution of its contemporary and early childhood nutritional determinants. The main research question that we aimed to answer in this study was formulated as follows:

What is the reproductive health status of adolescent girls and boys in Matlab, Bangladesh, and to what extent is this status associated with contemporary and early childhood nutritional anthropometry?

Despite being generally delimited by age, *adolescence* is primarily a social classification based on physical, mental and social markers of development, of which the origins are partly founded earlier in life, embedded within for instance the processes of physical maturation and socialisation. We considered adolescents' reproductive health status to be made up of a *physical* and a *mental* component. The main research question was split up into five specific research questions (see section 1.3), in this way accounting for the physical and mental well-being of adolescents' reproductive health. Below we answer the five research questions on the basis of the corresponding hypotheses (see section 3.2). However, we first briefly reflect on some theoretical considerations, the study design and the particularities of the study population (section 8.2). Conclusions based on analyses that shed light on the adolescents' physical well-being in terms of reproductive health are then drawn (section 8.3), followed by conclusions about the adolescents' reproductive well-being from a mental-emotional perspective (section 8.4). Finally, we formulate some recommendations for further research and intervention aimed at improving adolescents' contemporary and future reproductive health status (section 8.4).

8.2 Theoretical considerations, study design and population

We studied adolescents' reproductive health from a *lifecourse* perspective, which is one of the angles that can be taken within the *process-context* approach. Taking this approach to adolescents' reproductive health is rather new within the discipline of demography. The universal character of the lifecourse refers to the occurrence of stages, separated by transitions. Major reproductive transitions in early adolescence indicative for the *physical well-being* of adolescents' reproductive health are menarche and spermarche. The combined effect of inherited traits and environmental inputs mean that individuals can go through the respective stages at a different pace, and hence, that the timing of transitions differs. We analysed in particular the *timing of menarche* in relation to the *nutritional status career*, which is closely intertwined with the *reproductive health career*. Within the nutritional status career, the effects of early life growth failure may be passed on from one stage in life to the next, via the mechanisms of '*programming*' as proposed by Barker (1992) and '*cumulative causation*' (Kuh and Ben-Shlomo 1997), the accumulation of factors leading to nutritional deprivation. Moreover, the effects may be passed on to the next generation, so that an *intergenerational cycle* of growth failure results. In addition, a career of *knowledge and perceptions* may be distinguished. Adolescents' reproductive knowledge and perceptions reflect the *mental-emotional well-being* of adolescents' reproductive health.

Central to the discussion of physical and mental development was the notion of '*developmental readiness*', meaning that one develops in stages whereby progress through each stage is in part determined by success or lack of success in acquiring certain developmental tasks or traits in previous stages. *Developmental readiness* was addressed from two angles. First, we studied empirically the influence of early childhood nutritional status on age at menarche and, on the basis of secondary literature, the importance of age at menarche and contemporary nutritional status for reproductive health in early adulthood. Secondly, we studied empirically adolescents' knowledge and perceptions about reproductive transitions pertaining to the current stage in life (attainment of menarche and spermarche) and transitions pertaining to future reproductive health (marriage, childbirth).

By following the lifecourse approach we circumvented one of the main disadvantages present in most studies on (reproductive) health, i.e. a *cross-sectional* focus (comparing groups in terms of their current health and exposure status). A disadvantage of such an approach is that the health and exposure status are assessed simultaneously, while the origins of diseases and impaired (reproductive) health often go back to months or even years before. Studies on the long-term consequences of impaired nutritional status in the early stages of life have mainly been the domain of epidemiologists (for instance, Elo and Preston 1992; Kuh and Ben-Shlomo 1997; Kuh and Hardy 2002). Although the timeframe of our study is considerably shorter (up to early adolescence), here too we found (some) common ground with research conducted by, for instance, Barker who investigated the foetal and infant origins of several adult diseases. Our study follows directly from recommendations on research to be conducted in Matlab aimed at the association between nutritional status in early childhood and reproductive outcomes or anthropometric status in adolescence and early adulthood (for instance, Ross 1996, pp. 13-16).

Studying adolescents' reproductive health from a lifecourse perspective requires an analysis of *longitudinal data.* Our study involved the follow-up of 707 under-five children who were enrolled in a study on persistent diarrhoea conducted in Matlab in 1988-1989 by Baqui, a paediatrician affiliated with ICDDR,B. At the start of Baqui's study, April 1988, the youngest child enrolled was less than one month old, whereas the oldest child was almost four years old. His study served as a baseline for a follow-up survey in 2001. By that year (most of) the under-fives had grown up to be adolescents, aged 12 to 16 years. We succeeded in surveying the majority of the adolescents (569). In order to learn more about perceptions about reproductive health, additional information was collected among 18 adolescents, 8 parents and 3 local key persons by means of in-depth interviews. Almost all adolescents who were interviewed at follow-up were *unmarried*. Unmarried adolescents in Bangladesh are a marginalised group both in research and policy (Ross 1996, p. 8). However, unmarried adolescent *girls* merit attention as they are on the threshold of getting married and starting childbearing, and hence, passing on life to the next generation (currently 48 per cent of the 15 to 19-year-old girls in Bangladesh are married and the proportion of girls who gave birth by the age of 20 years is 63 per cent; Population Reference Bureau 2000, p. 21). That unmarried adolescent *boys* should also be informed is not only relevant for their own sake, but also important because of their role as husbands and fathers-to-be. If a man is sensitised from an early age onwards about reproductive issues, he may better be able to address the reproductive health related needs and aspirations of his wife later in life. Also in proportional as well as numerical terms adolescents are of the utmost importance (ICDDR,B 2002a, ICDDR,B 2002b).

As already noted in Chapter 1, conducting a longitudinal study in a developing country is rare. That we were able to link the data collected at baseline and at follow-up was feasible only because of the Registration IDentification (RID) number which is the key in the ICDDR,B's Health and Demographic Surveillance System (HDSS). It was also only because of the HDSS that we were able to analyse the records of the children who were *lost for follow-up* due to death or migration. Information on cause of death or migration was available for 106 individuals. The number of children who passed away before the onset of the follow-up study was small (n=11), which may be related to the fact that the majority (64 per cent) of the baseline population was already older than one year at the beginning of the (baseline) survey, and hence had passed the critical first 12 months of life. Far more under-fives (n=90) were lost for follow-up because of migration. At baseline, no differences in importance were observed in terms of demographics or socio-economic status between the 'survivors and stayers' and the children who would later die or migrate. At baseline, the proportions of children *severely* underweight and *severely* stunted appeared to be higher among the (few) children who passed away before the onset of the follow-up study than among the children who later enrolled in the follow-up study.

ICDDR,B does not systematically collect data on anthropometry (including birth weight) and menarche attainment. As in other studies (see, for instance, DHS 1997), we had to collect data on menarche (including maternal age at menarche) and birth weight *retrospectively*. Although the recall method of reported age at menarche may not be optimal, it is often the only way to collect this kind of information (see also Graham et al. 1999, p. 259). Due to the long period of recall the quality of this data may have suffered from a lack of objectivity and accuracy. Because of this some highly relevant hypotheses, including those that stem from an intergenerational perspective, could not be tested adequately.

Since the results presented in our study underscore the relevance of early childhood nutritional status for menarche attainment - and hint at the importance of birth weight for menarche - we highly recommend expanding the HDSS with a routine collection of data on anthropometry, from birth onwards, and menarche. Given the strong correlation with early childhood nutritional status, the average age at menarche of a population could also be considered as an indicator of the overall nutritional status and, possibly, the population's level of development (comparable to, for instance, indexes such as life expectancy or under-five mortality). In addition, age at menarche may gain in importance as a determinant in studies on maternal (obstetric) health and reproductive health in later life, for example regarding breast cancer (see, for instance, Dos Santos Silva and De Stavola 2002).

The aforementioned appeal should also be seen in view of the fact that more and more valuable input from other disciplines such as epidemiology, nutrition, sociology, anthropology and psychology is being successfully integrated into demographic studies. The present study can also be seen as a contribution to a further integration of some of these sciences into demography. The research design, described in Chapter 3, as well as the analyses of data presented in Chapters 5 and 6, relate for instance to epidemiology and nutrition. In Chapters 2 and 7 the *meaning* of adolescence was explored, as a consequence of which the study yields a more holistic view of the period of adolescent life in rural Bangladesh. The research was based on data derived from different sources whereby ample time was allotted to fieldwork, as described in Chapter 3. We not only built a database with data collected by means of *primary* methods of data collection (the follow-up survey), which we linked to *secondary* data (the baseline survey), but we also combined the *quantitative* (survey data) to *qualitative* information which we collected by means of in-depth interviewing (extracted phrases in which the real 'voices' of the respondents were heard). We believe that grounding the study in a variety of information sources may have contributed to the validity of the data.

8.3 Physical well-being of adolescents' reproductive health

8.3.1 Timing of reproductive transitions (*question 1*)

Research question 1 addressed the timing of the core transition in adolescence:

What is the reproductive health status of adolescent girls and boys as indicated by the timing of menarche and spermarche respectively?

Age at menarche

From the results presented in Chapter 6, we learned that among the 12 to 16-year-old girls in our sample (n=255) many had not yet reached menarche: the proportion of *postmenarcheal* girls increased from 7 per cent among 12-year-old girls to 81 per cent among 16-year-old girls. Over half, 52 per cent, of the *postmenarcheal* girls reached menarche at an age of 14 years or older, the cut-off point of what could be defined as a 'late' menarche when compared with contemporary Western countries. In addition, also 52 per cent of the *premenarcheal* girls was 14 years or older and therefore, according to this definition, 'late' with the reaching of menarche. This latter figure can be regarded as a lower limit as it may increase if *premenarcheal* girls who are currently 12 or 13 years old do not reach menarche before their 14th birthday. *Lifetable* analyses, which allow for censoring, revealed that the (expected) median age at menarche among the girls in our sample is 15.1 years.

Age at menarche in view of future reproductive health

Reaching menarche at the age of 14 years or older may be detrimental for reproductive health *if*, as outlined in Chapter 2, such a relatively 'late' menarche is followed shortly by the birth of the first child and the girl's height is low. This notion is grounded in the recognition that a) height and pelvic size are correlated; and b) at the time of reaching menarche girls have approximately 4 per cent more height and 12 to 18 per cent more pelvic growth ahead of them (WHO 1991, p. 6). From Chapter 5 we learned that 31 and 46 per cent of the adolescent girls in our sample are *moderately* (between -3 and -2 SD) and *severely* (<-3 SD) underweight in comparison to a well-nourished reference population of the same age and sex (CDC 2000). The corresponding proportions of stunting are 40 per cent (*moderate*) and 28 per cent (*severe*) respectively. In absolute terms, some of the girls in our sample are at risk because their weight and height fall below the cut-off points below which obstetric risks increase (for a height less than 145 cm and a weight lower than 45 kg there may be an obstetric risk; WHO 2003, pp. 22-23). The adolescent girls in our sample are likely not to have completed growth but their height and weight seem also to be subnormal because of malnutrition. *If* the 16-year-old girls in our sample married and became pregnant soon afterwards, 83 and 23 per cent respectively would be at risk in terms of obstetric cut-off points for weight and height.

Age at spermarche

Collecting data on spermarche turned out to be highly sensitive, something which was already expected given earlier studies on this topic, particularly in developing countries (WHO 1995; Hirsch et al. 1979). Nevertheless, among our sample of adolescent boys 40 out of 260 affirmed having experienced this event. Comparison of the age-specific distributions of adolescent girls and boys who had experienced menarche and spermarche respectively showed that girls are more advanced in terms of reproductive development than boys at every age between 12 and 16 years. A case in point is that among 14-year-olds, 40 per cent of the adolescent girls is *postmenarcheal,* against 4 per cent of the boys being *postspermarcheal*.

8.3.2 Menarche and nutritional anthropometry (*question 4*)

Research question 4 stemmed from the assumption that timing of menarche is predisposed by contemporary and early childhood nutritional anthropometry and possibly even set in utero:

Is timing of menarche predisposed by contemporary and early childhood nutritional anthropometry, birth weight, as well as height and age at menarche of the adolescent girl's mother?

Influence of maternal age at menarche

A late menarche may 'run in the family'. The review of studies (Chapter 2) showed that there is some evidence of a genetic predisposition on the timing of menarche, which is based on studies on twins and on a positive correlation between age at menarche of mothers and daughters. In Chapter 6 we analysed data on (recalled) age at menarche of adolescent girls and their mothers. We found neither a significant correlation between a mother's age at menarche and menarche status of her adolescent daughter (all girls included), nor a significant correlation between a mother's age at menarche and the age at menarche of her *postmenarcheal* daughter. This brought us to reject *hypothesis 1*, which stated that timing of menarche of mothers and daughters is positively, though weakly, correlated. It needs to be recalled, however, that prudence is required here because of the long period of recall (see also section 8.2).

Menarche and contemporary and early childhood anthropometry

The assumed influence of contemporary and early childhood nutritional status on age at menarche was confirmed in our descriptive analyses presented in Chapter 6. By means of descriptive analyses, lifetables and Cox regression models, we reviewed a) the stage in life (adolescence, early childhood or birth) that is most important with respect to the influence of nutritional status on menarche attainment; and b) within this stage, the type of nutritional status indicator (underweight, stunting or BMI) that has the strongest effect. It appeared that every contemporary and early childhood nutritional indicator that we included in the analyses had a significant effect on the rate of menarche when considered separately. As noted in Chapter 5, this also reflects the extent of *collinearity* between the independent variables. Illustrating the effect of contemporary stunting on menarche attainment yielded the followed results: *severely* (<-3 SD) and *moderately* (between -3 and -2 SD) stunted adolescent girls have a rate of menarche that is respectively 16 and 42 per cent of the rate for girls who are *not stunted* (>-2 SD) in adolescence (the reference group). This means that girls who are *severely* stunted in adolescence have the highest age at menarche. Significant effects on the rate of menarche were also found for *severely* underweight and stunting in early childhood. After controlling for the respective early childhood predictors (i.e. childhood underweight, childhood stunting and recalled birth weight), it appeared that adolescent stunting stood out as the most important (significant) determinant of age at menarche.

However, we believe that we cannot conclude that *only* adolescent stunting impacts on menarche attainment and that adolescent weight (or weight-for-age) and nutritional status in childhood are not factors of importance. Given that in extreme situations (famine, diet, physical exercise) menstruation (temporarily) stops (Napieralski and Devine 1998, p. 3) there seems to be a minimum of nutritional intake for reproductive functioning. Such a minimum - or to use Frisch and Revelle's term (1971), "critical weight" - is also likely to be present for the first menstruation, menarche. Given the strong correlation between stunting in early childhood and adolescence, which we found in Chapter 5 (see also subsection 8.3.4), adolescent stunting still resonates from the effect of stunting in early childhood. Following this line of thinking, the effects of nutritional status of the previous generation (the adolescent girls' mothers) should also not be ruled out as a factor possibly (indirectly) influencing age at menarche. Maternal height did not have a significant effect on the rate of menarche, but it appeared to be an important determinant of adolescent stunting. The results verified *hypothesis 2* that stated that adolescent girls who were malnourished according to anthropometry as an under-five child are more likely to reach menarche 'late' (i.e. 14 years or older when this event occurs) as compared to their well-nourished counterparts. *Hypothesis 3* stated that adolescent girls who were born with a low birth weight reach menarche earlier than girls with a higher weight at birth. The univariate Cox regression showed a significant effect of birth weight on the rate of menarche, but it lost its effect when other nutritional predictors, notably adolescent stunting, were taken into consideration. Since the data on birth weight are likely to suffer from a lack of validity (see also section 8.2), we do not find it feasible to draw a conclusion with respect to hypothesis 3.

8.3.3 Adolescent nutritional anthropometry and gender (*question 2*)

In research question 2 we addressed the contemporary nutritional status of adolescents, accounting for possible differences by sex:

What is the contemporary nutritional status, as indicated by anthropometry, of adolescent girls and boys, and does this differ by sex?

In *hypothesis 4* it was stated that adolescents' nutritional status, as indicated by anthropometry, is poor. In confirmation of this hypothesis it appeared that irrespective of the nutritional indicator used, the adolescent population in our sample can be considered largely malnourished. For instance, 66 per cent of the adolescent boys and 46 per cent of the adolescent girls are *severely* (<-3 SD) underweight, whereas 36 and

28 per cent of the adolescent boys and girls respectively are *severely* (<-3 SD) stunted. Particularly the high percentage of *severely* underweight boys calls for further (cross-country) comparison of nutritional data. However, information on adolescent nutritional anthropometry is scarce (United Nations 2000, p. 2), particularly within the Southeast region including Bangladesh (WHO 2003, p. 6; p. 14). Our study population has a slightly lower height and weight than their Indian peers (NNMB 2002): 15-year-old adolescent boys from Bangladesh are 149 cm tall and weigh 35 kg, whereas similarly aged boys from India are 152 cm tall and weigh on average 37 kg. Both our Bangladeshi and the Indian population are considerably smaller and lighter than their counterparts in the US: the US NCHS figures for height and weight for 15-year-old American boys are respectively 168 cm and 55 kg.

8.3.4 Early childhood and adolescent nutritional anthropometry (*question 3*)

The central contention in research question 3 is the notion that early childhood may be considered sensitive or critical for the adolescent stage in life:

Is nutritional anthropometry in adolescence predisposed by nutritional anthropometry in early childhood, birth weight, and height of the adolescent's mother? And, related to this, is there any potential to catch up early childhood growth faltering in adolescence?

We hypothesised that malnutrition, as indicated by the level of stunting, is more prevalent among adolescents who were stunted in early childhood than among adolescents who were not stunted as an under-five (*hypothesis 5*). Both from the descriptive as well as the univariate and multivariate binary logistic regression analyses, we learned that stunted under-fives are indeed highly likely to become stunted adolescents. For example, among boys who were *severely* (<-3 SD) stunted as an under-five[62], 71 percent remain *severely* (<-3 SD) stunted in adolescence. Also 48 and 17 per cent respectively of the *not stunted* under-five boys become *moderately* and *severely* stunted in adolescence. Compared to boys, a relatively high proportion of girls maintain an adequate nutritional status between early childhood and adolescence: 54 per cent of the girls remain *not stunted* (>-2 SD). The regression analyses revealed that, irrespective of sex, the odds of being stunted in adolescence for children who were *moderately* stunted in childhood is 1.64 times the odds for children who were *not stunted* in childhood, whereas the odds of being stunted in adolescence for children who were *severely* stunted in childhood is even 7.40 times the odds for children who were *not stunted* in childhood (reference category).

Moreover - as based on the findings of, for instance, Gillespie and Flores (2000) - we hypothesised that adolescents who were already stunted at the age of two years are more likely to remain stunted as compared to their not stunted same-aged counterparts in early childhood (*hypothesis 6*), and that girls are more likely to catch up early childhood growth faltering in adolescence than boys (*hypothesis 9*). Such a difference by sex could be biological in nature, related to differences in growth velocity (height), whereby boys generally peak later than girls. Results presented in Chapter 5 showed that for both boys and girls there is indeed some potential to catch up early childhood

[62] Nutritional status in childhood was assessed on the basis of comparison with the CDC/WHO reference population of 1978.

growth faltering (indicated by the level of stunting), but girls display a greater potential to improve their nutritional status, i.e. they are more likely to either consolidate a *not stunted* status or to turn from a *moderately* or *severely* stunted under-five into a *not stunted* adolescent. However, we also found that girls who were stunted *around the age of two years* do *not* have a greater potential to catch up faltering growth than their male counterparts in adolescence. Among children who did *not* suffer faltering growth around the age of two years girls are *less likely* than boys to become stunted in adolescence.

Given the prevailing low status of girls and women in many domains of life, we hypothesised that both in *early childhood* and *adolescence* girls are more likely to be malnourished as compared to their male counterparts (*hypothesis 8*). We observed that whereas on average *adolescent* girls are heavier compared to boys throughout the early and middle adolescent period, boys ultimately grow taller than girls, assuming that the nutritional status pattern (indicated by weight and height) pertaining to the ages 12 to 16 years prevails throughout the later stages of adolescence (ages 17 to 19 years). The turning point in height, i.e. when adolescent boys in our sample catch up with their female counterparts, is right after the age of 14 years. Contrary to what was hypothesised, we found that *adolescent* girls are less likely to be malnourished than boys. The binary logistic regression analyses revealed, for instance, that the odds of being stunted in adolescence for girls are about 0.4 times the odds for boys (reference category), meaning that girls are less likely to be stunted in adolescence as compared to boys. In early childhood however, girls are indeed relatively more often *severely* (<-3 SD) underweight and *severely* stunted than boys. However, if we consider two categories together - *moderately* and *severely* underweight and stunting - this difference is almost counterbalanced.

Finally, we hypothesised that the likelihood of being stunted in adolescence is greater for adolescents whose mothers are stunted than for adolescents whose mothers are not stunted (*hypothesis 7*). The descriptive analyses showed that 49 per cent of the adolescents whose mothers are less than 145 tall, is *severely* (<-3 SD) stunted. By comparison, it is 29 per cent for adolescents with taller mothers. Small mothers are more likely to have a child who is *severely* stunted in *early childhood* as compared to mothers who are not small. This apparent effect of maternal height on the stunting status of an (adolescent) child diminished completely, however, in the multivariate regression analyses and may thus only have an indirect influence (for instance, via childhood stunting). When we took all potential nutritional indicators together into consideration by means of binary logistic regression models, the variation in stunting in adolescence can be explained by the combined effect of the predictors, notably *sex* of the adolescent, *childhood stunting*, and possibly - see our reservations on the quality of the data in subsection 8.2.2 - *birth weight*.

8.4 Mental well-being of adolescents' reproductive health (*question 5*)

Research question 5 addressed the adolescents' reproductive knowledge and perceptions, both pertaining to current and future life:

Are adolescent girls and boys informed about and prepared for menarche and spermarche respectively, and reproductive development in general?

In Bangladesh, throughout the respective sub-stages of childhood and adolescence, girls are expected to learn their gender role at an earlier age than boys. Moreover, the period for adolescence in this country also seems to last longer for boys as they generally marry later. In adolescence, the world of girls and boys becomes increasingly segregated. The different approaches to the respective *rites of passage* which adolescent boys and girls in Bangladesh undergo illustrate the chasm between them. Although circumcision, which precedes spermarche, is of a different order from the onset of menarche, a common denominator shared with menarche is that it marks the entrance into the next stage of life, including the internalisation of the corresponding modes of conduct. In our study the average age at circumcision was 7.1 years (Chapter 7). With circumcision, the new status of an adolescent boy is celebrated with fanfare and in public, whereas the onset of menarche is kept silent and generally looked upon negatively because of the polluting nature of menstrual blood and the new 'dangerous state' of being sexually mature. The public acknowledgement of the transition from childhood to adulthood associated with circumcision contrasts sharply with the silence surrounding menarche. Given the gender-specific differences in adolescent socialisation, which we described in detail in Chapter 2, we hypothesised that adolescent girls and boys are not or insufficiently informed or prepared about menarche and spermarche respectively and reproductive development in general, and that girls are less informed than boys (*hypothesis 10*). This was subsequently studied in Chapter 7 on the basis of a combination of information collected by means of the (follow-up) survey and in-depth interviewing. The latter was held with selected (unmarried and a few married) *adolescents*, several *mothers* and *fathers* of adolescents, *ghatoks* (matchmakers) and a local *youth counsellor*. Coherence to the quantitative (survey) and qualitative (the 'voices') data was achieved by analysing both types of data jointly.

The social significance of menarche and spermarche was addressed first by analysing how adolescent girls and boys perceived the transition of menarche and spermarche respectively. A relatively high proportion of the *postmenarcheal* adolescent girls, 64 per cent, reached menarche in fear ('*I felt mainly scared*'), indicating low reproductive well-being from a mental-emotional perspective. Underlying this fear may be a lack of preparedness. The girls (and boys) whom we interviewed in-depth did not have any or had only a little knowledge about the physical origin of menarche (and spermarche respectively). The link with reproduction and the will of Allah, as indicated by some mothers, seemed to bestow menarche with 'religious preordainment'. For 44 per cent of the postmenarcheal girls, menstruation was accompanied by feelings of weakness. A smaller proportion (14 per cent) mentioned that they experienced headaches and moodiness on these days of the month. Nevertheless, in spite of this, menstruation is in general perceived positively because it is considered as a means to restore 'good health' by purging or washing away the 'bad blood'. Moreover, as was the case with menarche, menstruation is welcomed as an identification of womanhood.

Boys and girls differ when it comes to whether they talked to someone after the onset of spermarche and menarche respectively. Having someone to talk to may be especially important in view of the previous observations about the feelings of fear and anxiety that accompany reproductive transitions and the high number of premenarcheal girls not informed about their approaching menarche (65 per cent). The majority of the postspermarcheal boys (65 per cent) kept the reaching of spermarche silent, whereas the rest turned to friends. Postmenarcheal girls were not only much more likely to talk to someone after they experienced menarche (85 per cent talked to someone), but their social circle in this respect also seems much broader, ranging from friends to female family members. The role of mothers in this is slightly smaller than that of friends, sisters and aunts or cousins of adolescent girls. This has also been observed in other studies (see subsection 2.4.3).

Although adolescents said that they were informed about human procreation (84 per cent of the boys; 71 per cent of the girls) their *factual* knowledge seemed to be less substantial. About 70 per cent of the *postmenarcheal* girls confirmed the statement that a girl can indeed get pregnant the first time she has sexual intercourse, but only 6 per cent of them actually knew that a girl or woman is most likely to conceive approximately two weeks before or after the menstrual period. The proportion of adolescents who had 'ever heard' about contraceptives was relatively low: 34 per cent among the adolescent boys and - twice as high - 68 per cent among the adolescent girls. In this group, the majority (89 per cent) considered themselves to be 'informed'. However, detailed analyses of questions about how different methods of contraception worked showed that their factual knowledge was patchy. A similar finding was observed with regard to HIV/AIDS. A way needs to be found which does justice to the need for clarity on these topics and to ensure that the cultural norms about sexual propriety are not contravened.

The mean age at which a girl and a boy in Bangladesh should marry according to the adolescents in our sample is respectively 19 and 25 years. In Matlab, it is the parents who generally decide on the timing of the marriage. In the in-depth interviews some parents revealed that they base their decision on the timing of (the future) marriage of their daughter on their own experiences with (early) marriage and childbirth. Negative experiences with early childbearing of the parents may result in a later timing of marriage of their daughter.

Finally, the questions that some adolescents posed in the in-depth interviews were revealing. These questions display a great eagerness among both adolescent girls and boys to learn more about the basic facts relating to pregnancy and childbearing. Such eagerness for learning may serve as a catalyst in adolescent educational campaigns. From Chapter 4 we also learned that among the adolescents, school enrolment is high: 98 per cent has been to school (slightly more girls than boys) and 85 per cent was still school-going at the moment of interview at follow-up. The adolescents in our sample were much better educated than their parents. For instance, at baseline, the proportion of fathers and mothers who had not completed a single year of education amounted to 53 and 75 per cent respectively. That more and more girls, also in rural areas, are enrolled in schools nowadays was also observed by Blanchet (1996, p. 57). She points out that this increase in female education may indicate more room for childhood and adolescence. As a consequence, the *meaning* attributed to the adolescent stage in life may change as well as reproductive health needs. Important factors to keep in mind, when setting up reproductive education and counselling programmes, are not only the differences in knowledge between boys and girls but also the different sources of information (persons) about reproductive matters, as has become apparent in our study. In a study by the Population Council Dhaka, it was found that male adolescents preferred a mass media message, whereas female adolescents preferred a personal transfer of information regarding reproduction and sexuality (Haider et al. 1997).

8.5 Recommendations for further study and intervention: research for action

In this study we focussed on the three core elements of life history analysis, namely "describing, explaining and predicting" (Willekens 1999, p. 31). More specifically, our aims were to:

- describe contemporary (reproductive and nutritional) status within a broader timeframe (i.e. any period between conception to death);
- explain this contemporary status (menarche, adolescent nutritional anthropometry) by examining conditions or features in the past (early childhood nutritional anthropometry); and
- outline the possible consequences of contemporary status (age at menarche, nutritional anthropometry) for future events (childbearing).

The first two objectives were studied empirically, whereas the third, explored by means of literature review, relates particularly to the *justification* of the subject of study. Age at menarche, our main outcome indicator, is not only an indicator of reproductive health status *per se*, but it may also be crucial for the rest of the reproductive career. Age at menarche appeared to carry both physical (pertaining to the *biological clock*) and social significance (relating to the *social clock*). In order to turn the vicious circle of intergenerational growth failure and impaired reproductive knowledge into a virtuous one whereby adolescents are well prepared, both physically and mentally, for reproductive transitions pertaining to the *current* stage in life as well as to their *future* reproductive life, an undertaking could be made to have the *research followed by action*, an approach which is in line with the ICPD action programme as well as the programmes of HERA and ICDDR,B. Next, we will outline some recommendations for research or intervention aimed at improving the *contemporary* (subsection 8.5.1) and *future* reproductive health status of adolescents (subsection 8.5.2).

8.5.1 Contemporary reproductive health status

As stated by Napieralski and Devine (1998, p. 4), "age at menarche is beyond our control". Given our results, however, this remains to be seen. In our study we concluded that menarche is indeed reached 'late' for a considerable proportion of the girls due to low contemporary nutritional status, particularly indicated by *severely* stunting, which was in turn associated with malnutrition in early childhood (see section 8.2). A girl who finds herself on the threshold of adolescence may indeed not be able to alter the timing of her coming menarche. However, for malnourished girls in early childhood (particularly in infancy), but possibly also in late childhood, i.e. between the ages of 6 to 12 years (a population under-addressed in contemporary research), it may still be feasible to improve nutritional status and catch up part of the deficit of early childhood growth. On the basis of stunting profiles in particular, monitoring systems should be formulated, aiming at singling out those pre-adolescent girls who run a risk of reaching their menarche 'late' so as to programme urgent nutritional aid for them. In addition, the results presented in Chapter 7 underscore the need to address the adolescents' needs with regard to reproductive health education. It is worth noting that maintenance of proper nutritional status from birth onwards also adds to mental well-being in later life (see, for instance, Lachance 1995 pp. 9-12; Gillespie and Flores 2000, p. 2).

In order to improve the reproductive health status of the adolescents involved (and the generations that follow), a proposal could be developed to translate results of the research into an educational or health campaign on nutrition and reproductive health. Since the development of Information Education and Communication (IEC) activities as such is beyond the scope of the work of researchers, co-operation with a local NGO (Non-Governmental Organisation) is required. For years, such a translation of research into action has formed an integrated part of general health research. In demographic research, however, the inclusion of an action component is rather new. With respect to programming *nutritional* intervention in developing countries, attention has traditionally not been paid to adolescents (WHO 2003, p. 5), though some successful programmes have been implemented in Bangladesh (for instance, by the Population Council 2003 and Marie Stopes International 2003b).

8.5.2 Future reproductive health status

A comparison of our data on age at menarche with data published in other sources on age at first birth in Bangladesh (see also section 8.4) yields a relatively small time gap between these two events. Also, apparently irrespective of their social and cultural diversity, adolescents start sexual activity at about the same age in both developed and developing countries (UNFPA 1997). It is as yet not known exactly how a pregnancy in an adolescent girl interferes with her own growth and reproductive maturation process (Riley et al. 1993, p. 56). There are indications that catch up early life growth faltering in adolescent girls is characterised by a growth that continues longer than usual, while growth velocity does not change (Riley 1994, p. 92; Silventoinen 2000, p. 23). This may have serious implications for adolescent girls' reproductive health, because then reproductive organs (for example, the pelvis) take longer to reach maturity (height is correlated to pelvic size). Consequently, these girls would typically reach physical 'readiness' for childbirth also at a later stage. These observations have implications for *gynaecological* age, the time in years since menarche. Young *gynaecological* age (immaturity of the young mother-to-be) may not only jeopardise the course and outcome of the pregnancy, but it is likely to increase the risk of obstructive labour as well, endangering both the life of the adolescent mother and that of her baby. *Gynaecological* and *biological* age (indexed by nutritional status) rather than chronological age seem more important to an adolescent girl's reproductive health status.

More research is required in order to verify the validity of such a hypothesis. For instance, as a sequel to the present study, future research could entail a third round of data collection (a second follow-up) among the *female* individuals of our study population at the time their marital lives begin. The focus in such a study would be on reproductive health, indicated particularly by the course and outcome of the first pregnancy, in relation to the young woman's gynaecological age and her nutritional status career. Such research would also aim to throw more light on weight and height cut-off points that reflect a potential obstetric risk for the *Bangladeshi* population in particular.

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Appendix A: Glossary

chachi	aunt, mother's side
balyakal	late childhood (Aziz and Maloney 1985)
bandhobi	a very close (female) friend, amounting virtually to fictive kinship (White 1992, pp. 89-91)
bari	a sub-unit within a village, literally (kin-related) 'homestead' organised around common courtyard (Fauveau 1994, pp. 17-19; Carr et al. 1997, p. 222)
bou	housewife or wife (Blanchet 1996); bride, daughter-in-law
bou-chee	game played by 8 to 15-year-old girls, which prepares for modes of conduct related to *purdah* (Begum 2000)
crore	ten million *taka* (Carr et al. 1997, p. 222)
cula	a household unit or hearth group (Fauveau 1994, pp. 17-19)
dai	traditional birth attendant (Blanchet 1996, pp. 50-51); midwife
dangoli	game played by boys
dhormo	the right action according to the stage of life (Aziz and Maloney 1985, p. 7); a by god-ordained life path or religion
dhonnobat	thanks
dowry	transfer of money or valuables from the family of the bride to the groom and his family (Amin and Cain 1997, p. 296)
fufu	aunt, father's side
ghar	housing unit which accommodates all members of a particular family; *ghar* membership is mainly based upon patri-virilocal residence and it is the primary unit of production and consumption (Fauveau 1994, pp. 17-19)
izzat	honour related to sexual 'ignorance' of (adolescent) girls and preservation of virginity until marriage (Mkuhopadhyay and Savithri 1998, p. 28)
jati	one's inherited religious or occupational group, and gender (Blanchet 1996, p. 33)
joutuk	the opposite of *dowry*; *joutuk* is paid by the groom's family to the bride's (Amin and Cain 1997, pp. 290-293)
kaisor	early adolescence (Aziz and Maloney 1985)

kaisorer prarambha	pre-adolescent stage (Aziz and Maloney 1985)
khat	bed
kurite buri	a saying in Bangladesh that a women is old at the age of 20 years
lakh	one hundred thousand *taka* (Carr et al. 1997, p. 222)
lungi	pair of trousers worn by men
mashik	menstruation
moulavi	religious leader, religious teacher
nabajauban	late adolescence or youth (Aziz and Maloney 1985)
nabalak	prespermarcheal boy
nabalika	girl who has not yet reached menarche; premenarcheal girl
nekra	cloth
orna	scarf
purdah	a socio-cultural norm, perpetuated by religion, that defines women's roles by enforcing a high standard of female modesty, dictating propriety in deed and thought, restricting mobility, limiting autonomy (Ross 1996, p. 33); female seclusion (Carr et al. 1997, p. 223)
sabalak	literally 'he who has semen', but generally based on the appearance of secondary sexual characteristics (Aziz and Maloney 1985); postspermarcheal boy
sabalika	girl who has reached menarche; postmenarcheal girl
samaj	society, referring to mosque-based societies that function as social units during ceremonial and religious occasions, such as marriage and funerals (Carr et al. 1997, p. 223)
saree	dress, worn by women
shelwar kamiz	dress, worn by girls
sisukal	pre-school age (Aziz and Maloney 1985)
thana	regional unit, comparable with a sub-district (Fauveau 1994, p.13); Bangladesh is divided into 6 divisions, 64 districts and 490 sub-districts

Appendix B: Consent form

Consent Form: 'Explanation of the study' & 'Your rights as a research participant'

*[Interviewer: Please read out loud the statements below to the potential participant before beginning the interview. Only after the potential participant indicates that the explanation of the study and his or her rights as a participant are fully understood, and if the participant agrees to participate, you may ask him or her to sign or thumbprint the consent form (**see end of page**).]*

Title of study Adolescents' reproductive health in rural Bangladesh

Person(s) in charge Mrs. Alinda Bosch

Explanation of study

This study in which we ask you to participate is part of a research project that studies the reproductive health status of adolescents. The study takes physical and mental maturity processes, as well as socio-cultural, economic and demographic conditions, into account. With this research we hope to gain more insight into adolescents' reproductive health status and its determinants and to contribute to further research and action in this field. You are selected for this study because you were also enrolled in a study that was conducted by Dr. Baqui in 1988-1989, when you were still a little boy/girl. Today we want to study how you are doing and how your nutritional status is almost 13 years later.

Procedure

If you agree to participate in this research you will be asked to answer questions about your <u>socio-economic, marital</u> and <u>nutritional</u> status. If applicable, we also ask you about your fertility history, and your knowledge, perceptions, attitudes, and expectations with regard to <u>reproductive</u> and <u>family life matters</u>. In order to have an idea of your nutritional status, we will take anthropometric measurements: weight, height and mid-upper arm circumference. By comparing your current nutritional status with your nutritional status during early childhood, we hope to gain more insight into adolescents' reproductive health and the factors that are associated with it. Your participation in this research will take a total of about 1-1.5 hours.

Your rights as a research participant: confidentiality, risks and benefits

You may ask any question about the research project and the procedure. Questions will be answered as long as they do not refer to information pertaining to other participants. Your participation in this research is confidential. We will make every effort to minimise the risks of your answers being made known to others. We therefore promise that publications based on the research will not include your name, ID-number, or any other information that may reveal your identity. Your participation in this research is voluntary, which implies that you are free to stop participating in the research at any time or to refuse to answer a question. We assure you that there is no possibility that your participation in this research will harm you or your family. Also, if you refuse to participate or withdraw at any time, no harm will come to you or your family. Participating in this study has no direct benefit to you or your family. The results of this research may however help us further address the needs of adolescents in your community, e.g. by setting up a health education campaign, especially aimed at improving the reproductive health status of adolescents and the generations that follow.

[Interviewer: read out to the participant:] **I, participant/name of respondent:**

1 agree to participate in a scientific research project entitled "Adolescents' reproductive health in rural Bangladesh: the impact of early childhood nutritional anthropometry".
2 understand the information given to me and I have received answers to any questions I had about the research project or the procedure.
3 understand and agree to the conditions of this study as read out to me.
4 have, to the best of my knowledge and belief, no physical or mental illness or difficulties that would pose any risk to me because of participation in this study.
5 understand that I will receive no compensation for my participation.
6 understand that my participation in this research is voluntary and that I may withdraw from this study at any time by notifying one of the persons in charge and/or the interviewer.
7 understand that I can receive a signed copy of this document.

			Day	Month
Signature of participant:	…………………………………	**Date**	☐☐	☐☐
Signature of guardian:	…………………………………	**Date**	☐☐	☐☐

Copy of verbal consent form given to participant (if requested): **1** Yes **2** No

[To be filled in by the interviewer:] I certify that the informed consent procedure has been followed and that I have answered any questions of the participant and/or his guardian - see above - as fully as possible.

			Day	Month
Signature of interviewer:	…………………………………	**Date**	☐☐	☐☐

This informed consent form has been translated into Bangla by an interpreter of ICDDR,B.

Appendix C: Questionnaire for follow-up survey

Confidential

ADOLESCENTS' REPRODUCTIVE HEALTH IN RURAL BANGLADESH: THE IMPACT OF EARLY CHILDHOOD ANTHROPOMETRY

Questionnaire for never-married adolescents

Contents:

A cooperation between:

International Centre for Diarrhoeal Disease Research, Bangladesh &

HERA (HEalthy reproduction: Research for Action), The Netherlands.

Funded by:

The Netherlands Foundation for the Advancement of Tropical Research (WOTRO) &

HEalthy reproduction: Research for Action (HERA)

Cover page

Sex of respondent *1= male; 2 =female*	☐	**RID** **CID**	☐☐☐☐☐☐☐☐☐☐ ☐☐☐☐☐☐☐☐☐
Name of respondent	…………………………	***Bari*:**	…………………………
Name of father/husband	…………………………	***Bari* number**	☐☐☐
Name mother/wife	…………………………	**Village:**	…………………………
Year of birth *[pre-filled]*	*19* ☐☐	**Village ID code**	☐☐☐
		***Thana*:**	MATLAB
Total number of persons in household:	☐☐	***Thana* ID code**	☐☐
		District:	CHANDPUR
Questionnaire number *[pre-filled]*	☐☐	**District ID code**	☐☐

Interview visits

First interview attempt		**Second interview attempt**		**Third interview attempt**	
Name & ID number	☐	**Name & ID number**	☐	**Name & ID number**	☐
………………………………		………………………………		………………………………	
Date	☐☐	Date	☐☐	Date	☐☐
Month	☐☐	Month	☐☐	Month	☐☐
Time started:		**Time started:**		**Time started:**	
Hour	☐☐	Hour	☐☐	Hour	☐☐
Minute	☐☐	Minute	☐☐	Minute	☐☐
Time finished:		**Time finished:**		**Time finished:**	
Hour	☐☐	Hour	☐☐	Hour	☐☐
Minute	☐☐	Minute	☐☐	Minute	☐☐
Result*	☐☐	Result*	☐☐	Result*	☐☐

***) Result codes:**

1 Completed
2 Household present, but adolescent absent *[If so, ask:]*
When is the adolescent back? ………………………………..
At what time is he/she back? ………………………………..
3 Entire household absent
4 Address not found/does not exist
5 Empty *bari*: house is vacant/no dwelling/destroyed
6 Interview refused *[Ask reason for refusal]:*
- **60** No reason given
- **61** Illness/sick
- **62** Husband does not allow
- **63** Father and/or mother (in-law) does not allow
- **64** No time

71 Adolescent died
72 Adolescent not capable of being interviewed (handicapped)
8 Adolescent migrated *[Ask where he/she moved to: address]*
- **80** Don't know where he/she moved to
- **81** Within Matlab: …………………………………
- **82** To Dhaka: …………………………………
- **83** Somewhere else: …………………………………
- **84** Abroad: …………………………………

9 Interview broken off (*see also Z6*)
10 Other or incomplete, specify: …………………………

Tot no. of visits: ☐

Data entered by (1):
………………………………
Day ☐☐ Month ☐☐

Data entered by (2):
………………………………
Day ☐☐ Month ☐☐

Name of Supervisor field
………………………………
ID Supervisor field ☐
Day ☐☐ Month ☐☐

Consent form:
Tick if signed: ☐

Module I: Introduction

[Interviewer: This information is to be obtained from the adolescent's biological mother. If the adolescent lives in the house of family-in-law GO TO Module A]

You may remember that Dr. Baqui carried out a study in 1988-1989 on diarrhoeal diseases. Your child *[Name of adolescent]* was enrolled in this study. Many years have passed by since the day *[Name of adolescent]* was born. We would like to ask you some questions about his/her birth.

I1 Do you remember how old you were when *[Name of adolescent]* was born? — **I1** Age ☐☐

I2 Do you remember whether *[Name of adolescent]* was born in time/early/late? — **I2** ☐

- **1** In time → **GO TO I4**
- **2** Early → **I3** Approximately, how many weeks early or late?
- **3** Late → **I3**
- **9** Don't know → **GO TO I4**

I3 ☐☐ No.

I4 Do you remember the size of *[Name of adolescent]* at the time he/she was born? He/She was *[Interviewer: read categories 1 to 3 aloud:]* — **I4** ☐

- **1** Normal in size as compared to other babies
- **2** Small as compared to other babies
- **3** Long as compared to other babies
- **9** Don't know

I5 Do you remember the approximate birthweight of *[Name of adolescent]*? — **I5** ☐

- **1** Yes → **I6** How much, approximately, in grams?
- **2** No

I6 Grams ☐☐☐☐

I7 Did you breastfeed *[Name of adolescent]*? — **I7** ☐

- **1** Yes → **I8** For how many months?
- **2** No

I8 Months ☐☐

[Male Interviewers: GO TO Module A; Female Interviewers: GO TO I9]

I9 Do you remember at what age you had your first menstruation? — **I9** ☐☐

→ **GO TO Module A**

Module A: General profile

A1 Who are the members of your household: can you indicate those who usually live in your household?
[Interviewer: a household includes all those who eat from the same chula]

Father	**A1a** ☐	Grandfather	**A1g** ☐	Father-in-law	**A1m** ☐
Mother	**A1b** ☐	Grandmother	**A1h** ☐	Mother-in law	**A1n** ☐
Brother(s)	**A1c** ☐	Uncle(s) (all sides)	**A1i** ☐	Brother(s)-in-law	**A1o** ☐
Sister(s)	**A1d** ☐	Aunt(s) (all sides)	**A1j** ☐	Sister(s)-in-law	**A1p** ☐
Husband or wife	**A1e** ☐	Cousins/nephews	**A1k** ☐	Other in-laws	**A1q** ☐
Child/children	**A1f** ☐	Other family	**A1l** ☐	Non-relatives	**A1r** ☐

A2 How many people live in your household? — **A2** No. ☐☐

A3 How old are you? *[self-reported thus not from cover page]* — **A3** ☐☐

A4 What is your religion? — **A4** ☐

- **1** Islam
- **2** Hinduism
- **3** Buddism
- **4** Christianity
- **5** Other

Continuation Module A: General profile

A5 How many times do you go to the mosque/temple/church?

1 Five times/day **3** Once a week **5** Never
2 Three times/day **4** Not very often

A5 ☐

A6 Have you ever attended school?

1 Yes → **GO TO A8**
2 No → **A7** Why did you not attend school? *[Do **not** read aloud]*

School far away	**A7a** ☐	I was (am) ill/sick	**A7e** ☐
Couldn't afford it	**A7b** ☐	Don't know	**A7f** ☐
Had to work/help	**A7c** ☐	Other, specify:	**A7g** ☐
I am a girl	**A7d** ☐	…………………………………	

→ **GO TO A11**

A6 ☐

A8a What is the highest class successfully completed at school?
A8b What type of school? *[See Annex]*

A8a ☐☐
A8b ☐

A9 Are you still going to school?

1 Yes → **GO TO A11**
2 No → **A10** Why did you leave school? *[Do **not** read aloud; select main reason]*

1 Completed school
2 Reached menarche
3 Got married
4 Got pregnant
5 Work/help in household
6 Could no longer afford it
7 Family reasons
8 Don't know
9 Other, specify: …………

A9 ☐
A10 ☐

A11 Do you have an occupation?

1 Yes → **A12** What is your main occupation? *[See Annex]*
A13 What is your 2nd occupation? *[See Annex]*

A14 How many hours ***per day*** do you work in total?
A15 What it your total ***monthly*** income from all ***your*** occupations? *[If no income,* ***GO TO A17****]*

A16 Do you keep your salary yourself or do you give (most of) it to others? Specify to whom.

Myself	**A16a** ☐	Family	**A16d** ☐
Parents	**A16b** ☐	In-law family	**A16e** ☐
Spouse	**A16c** ☐	Others	**A16f** ☐

2 No ↓

A11 ☐
A12 ☐☐
A13 ☐☐
A14 ☐☐
A15 *taka* ☐☐☐☐

A17 What do you mainly do when you are not working or in school?
*[Do **not** read aloud; tick if mentioned]*

Cooking	**A17a** ☐	Hanging out (male friends)	**A17f** ☐
Collecting fuel for cooking	**A17b** ☐	Helping mother with work	**A17g** ☐
Collecting drinking water	**A17c** ☐	Helping father with work	**A17h** ☐
Other domestic work	**A17d** ☐	Doing homework (school)	**A17i** ☐
Hanging out (female friends)	**A17e** ☐	Other, specify: …………….	**A17j** ☐

A18a What is the highest level of education of your father/male caregiver?
A18b What type of school? *[See Annex]*

A18a ☐☐
A18b ☐

A19a What is the highest level of education of your mother/female caregiver?
A19b What type of school? *[See Annex]*
A20 Do you or any of your family or family-in-law hold a special position?

1 Yes → **A21** What kind of position? *[Do **not** read aloud; tick if mentioned]*

Union Parishad member	**A21a** ☐
Teacher	**A21b** ☐
Village doctor (traditional healer)	**A21c** ☐
Local politician	**A21d** ☐
Midwife	**A21e** ☐
Other, specify: ……	**A21f** ☐

2 No ↓

GO TO Module B

A19a ☐☐
A19b ☐
A20 ☐

Module B: Living conditions

B1 How many rooms (living room, bedroom, kitchen, etc.) are there in the house for the exclusive use of your household? — **B1** [ ][ ] No.

B2 What type of flooring is used in the respondent's bedroom? *[Verify]* — **B2** [ ]

1 *Pucca* /cement **2** Bamboo **3** Wood **4** Mud

B3 What are the walls made of? *[Verify]* — **B3** [ ]

1 *Pucca* /cement **3** Wood **5** Tin **7** Other, specify: ………………
2 Bamboo **4** Leaves/straw **6** Mud

B4 What is the roof made of? *[Verify]* — **B4** [ ]

1 *Pucca* /cement **3** Wood **5** Tin
2 Bamboo **4** Leaves/straw **6** Other, specify: …………

B5 Does the household utilise electricity? — **B5** [ ]

1 Yes → **GO TO B7**
2 No → **B6** Does any other household in this village utilise electricity? **1** Yes **2** No — **B6** [ ]

B7 What is the MAIN source of drinking water in this house? — **B7** [ ]

1 Tap/piped water →
2 (Hand) tube well →
3 (Regular) well →
4 Pond/lake →

→ **B8** Does your household own this source of drinking water? **1** Yes **2** No — **B8** [ ]

5 Canal **7** Rain water
6 River **8** Other source

B9 Where is the main drinking water source located? → — **B9** [ ]

1 Inside house
2 Outside house but inside *bari*
3 Outside *bari*

B10 What type of toilet is used in this household? — **B10** [ ]

1 Own sanitary latrine/septic tank **4** Shared/public tradit. pit latrine
2 Shared sanitary latrine/septic tank **5** *Kuccha* (hole in the field)
3 Own traditional pit laterine **6** Other, specify: ……………

B11 What type of fuels are used in this houshold for cooking? *[Read aloud]*

Wood	**B11a**	[ ]	Straw/jute/rice husk/leaves	**B11d**	[ ]
Kerosene	**B11b**	[ ]	Cow/animal dung	**B11e**	[ ]
Elect./gas	**B11c**	[ ]	Charcoal	**B11f**	[ ]

B12 Is this house or homestead owned, rented or lived in free of charge? — **B12** [ ]

1 Owned by family member **4** Others provide the house (free)
2 Rented **5** Other arrangements
3 Employer provides the house (free)

B13 Does this household own the following items? *[Read categories aloud]*

Radio	**B13a**	[ ]	Wooden or steel bed	**B13i**	[ ]
Television	**B13b**	[ ]	Sewing machine	**B13j**	[ ]
Watch/clock	**B13c**	[ ]	*Almira*	**B13k**	[ ]
Electric fan	**B13d**	[ ]	Generator/engine/tractor	**B13l**	[ ]
Boat	**B13e**	[ ]	Telephone	**B13m**	[ ]
Bike/bicycle	**B13f**	[ ]	Cow/buffalo/goat	**B13n**	[ ]
Rickshaw	**B13g**	[ ]	Chicken/pigeon/duck	**B13o**	[ ]
Babytaxi/van	**B13h**	[ ]	Other animal	**B13p**	[ ]

B14 Do you own any jewellery/gold accessories? — **B14** [ ]

1 Yes → **B15** How many *taka* are they worth? — **B15** *taka* [ ][ ][ ][ ][ ][ ]
2 No

B16 Does this household own any land, such as homestead or ploughing land? — **B16** [ ]

1 Yes → **B17** How many *taka* would it cost, approximately, for someone to buy the land your household owns? — **B17** *taka* [ ][ ][ ][ ][ ][ ]
2 No → **GO TO Module E**

B18 Who owns the land? **1** Father **2** Grandfather **3** Other family member **4** Other, specify …… — **B18** [ ]

Module E: Contraception

E1 *[Female adolescents:]* Do you know how a woman can get pregnant? **E1** ☐
[Male adolescents:] Do you know how a man can become a father?
1 Yes → **E1a** How do you think this happens? ……………………………..…………………………
2 No ↓

E2 There are various ways for a couple to prevent or delay having children. Have you ever heard of any of such methods or practices? **E2** ☐
1 Yes ↓ **2** No → **GO TO Module F**

E3 Have you or your partner ever used any contraceptive method? **E3** ☐
1 Yes → **GO TO E4** **2** No → **GO TO E9**

E4 Why did you start using a contraceptive method? **E4** ☐
1 Too young to have a child
2 Not enough money to feed a child
3 Decision of mother-in-law
4 Decision of husband
5 Other, specify: ……………

E5 How old were you when you started using contraceptives? **E5** ☐☐ Yrs

E6 What method did you or your partner start with? **E6** ☐☐
1 Contraceptive pill
2 IUD (Copper T/plastic coil)
3 Contraceptive injection
4 Diaphram (foam/jelly)
5 Condom
6 Contraceptive tubes (implants/Norplant)
7 Female sterilisation (tubectomy)
8 Male sterilisation (vasectomy)
9 Withdrawal/*azal*
10 Safe period/rhythm method
11 Other, specify: ……………….

E7 Do you or your partner currently use any contraception? **E7** ☐
1 Yes → **GO TO E9** **2** No → **GO TO E8**

E8 What is the most important reason to stop using contraception? **E8** ☐☐
1 I want(ed) to have a child
2 Husband/ wife want(ed) to have a child
3 Husband forbade it
4 Mother-in-law forbade it
5 Other-in-laws forbade it
6 Afraid of pills
7 Marital dissolution/separation
8 Reduces breastmilk
9 Causes infertility
10 Irregular menstruation
11 Makes the woman fat
12 Other side-effects
13 Costs too much
14 Post-partum amenorrhea
99 Don't know

E9 Can you explain how the following methods prevent a pregnancy, that is, how does it work? *[Read out the methods below: an explanation is correct if a and b are mentioned, fill in '1'. An explanation is nearly correct if a or b is mentioned, fill in '2' and* ***underline*** *the correct part. If the explanation is not at all correct, fill in '3. If the respondent does not know or has never heard of it, fill in '9'.]*

E9a	☐	Contraceptive pill	a) a pill contains hormones; b) to be taken every day by the woman
E9b	☐	IUD (Copper T/plastic Coil)	a) spiral, loop or coil inserted into woman's uterus by a physician or midwife; b) remains there for several months
E9c	☐	Contraceptive injection	a) injection given to a woman to prevent pregnancy; b) needs to be repeated after several months
E9d	☐	Diaphram (foam/jelly)	a) to be inserted in a woman's vagina before intercourse; b) to be applied every time before intercourse
E9e	☐	Condom	a) to be worn by a man before intercourse; b) to be put on every time before having intercourse
E9f	☐	Contraceptive tubes (implants/Norplant)	a) tubes implanted in a woman's arm b) to be renewed about every 6 months
E9g	☐	Fem. sterilis. (tubectomy)	a) woman undergoes surgery; b) permanent method
E9h	☐	Male sterilis. (vasectomy)	a) man undergoes surgery; b) permanent method

Continuation Module E: Contraception

E10 If a woman takes the pill properly how sure can she be that she will not become pregnant:
1 Completely **3** Fairly sure **9** Don't know
2 Almost sure **4** Not sure at all

E10 ☐

E11 In your opinion, what is the safest contraceptive method to prevent or space a pregnancy *[Do **not** read out and fill in '9' if respondent doen't know]*.

1 Condom
2 Pill
3 Withdrawal/*azal*
4 IUD
5 Safe period/rhythm method
6 Tubectomy/vasectomy
7 Other, specify: ……………………
9 Don't know

E11 ☐

E12 Were you informed about the use of contraceptives?
1 Yes → **E13** Who or what medium informed you about the use of contraceptives? *[First source]*
1 Mother
2 Mother-in-law
3 Husband/wife
4 Doctor
5 Healthworker
6 Midwife
7 Teacher
8 Tv/radio/paper
9 Other, specify: …………………………
2 No

E12 ☐
E13 ☐

E14 For each method mentioned, can you tell us at least one place where one can obtain this method? *[Read out loud: 1=correct; 2=wrong; 9=Don't know]*

Contraceptive pill	**E14a** ☐	Condom	**E14e** ☐
IUD	**E14b** ☐	Contraceptive tubes	**E14f** ☐
Contrac. injection	**E14c** ☐	Female sterilisation	**E14g** ☐
Diaphram	**E14d** ☐	Male sterilisation	**E14h** ☐

E15 For each method mentioned, can you also tell us how much it costs in *taka*? [*Interviewer: read categories aloud. Fill in '999' if respondent does not know price. For free is '000'. Note: per piece; only 'pill' is per month]*

		taka			*taka*
Contraceptive pill	**E15a**	☐☐☐	Condom	**E15e**	☐☐☐
IUD	**E15b**	☐☐☐	Contr. tubes	**E15f**	☐☐☐
Contr. injection	**E15c**	☐☐☐	Tubectomy	**E15g**	☐☐☐
Diaphram	**E15d**	☐☐☐	Vasectomy	**E15h**	☐☐☐

→ **GO TO Module F**

Module F: Ambitions and expectations

F1 Would you like to have children in the future?
- **1** Yes → **F2** How many?
- **2** No

F3 At what age would you prefer having your first child?

F4 Do you have any preference concerning the sex of the child(ren)? *[Do **not** read out]*
- **1** I would like to have sons only
- **2** I would like to have at least one son
- **3** I would like to have at least one daughter
- **4** I would like to have at least one son and daughter
- **5** I do not have any preferences
- **6** Other specify: …………………..

F5 What do you think is the ideal number of children for a Bangla family?

F6 Are/were you interested in the subjects at school?
- **1** Yes, very interested
- **2** Yes, somewhat interested
- **3** No, not at all interested
- **8** Never went to school
- **9** Don't know

F7 What is/were your results in school: do you think they are/were:
- **1** Better than others
- **2** Worse than others
- **3** Similar to the others
- **8** Never went to school
- **9** Don't know

F8 What level of education would you like or would you have liked to achieve?
- **1** No educational ambitions
- **2** Primary school at the highest
- **3** Secondary school at the highest
- **4** College at the highest
- **5** University
- **9** Don't know

F9 What job would you ***like*** to have in the future? *[See Annex]*

F10 Do you expect to stay in Matlab in the future?
- **1** Yes, I'll stay → **GO TO Module K**
- **2** No, I'll migrate → **F11** To where?
- **3** I don't know yet → **GO TO Module K**

F11 To where?
- **1** Dhaka
- **2** Other city/town
- **3** Other village
- **4** India
- **5** Middle East
- **6** Europe/US
- **7** Other place
- **8** Don't know yet

→ **GO TO Module K**

F1	☐
F2	☐☐ No.
F3	☐☐ Yrs
F4	☐
F5	☐☐
F6	☐
F7	☐
F8	☐
F9	☐☐
F10	☐
F11	☐

Module K: Reproductive health and development

[Male interviewers: Start with K17; Female interviewers: Start with K1]

K1 *[For girls]* Do you have *mashik* (menstruation)? — **K1** ☐

- **1** Yes → **GO TO K6**
- **2** No

K2 *[Nabalaks only:]* Do you know what is meant by this term? — **K2** ☐

- **1** Yes → **K3** By whom or what were you informed? *[First source]* — **K3** ☐
- **2** No

1	Mother	**8**	Friend
2	Father	**9**	Health or FP worker
3	Sister	**10**	Doctor
4	Grandmother	**11**	Television/radio
5	Aunt	**12**	Newspaper/magazine
6	Mother-in-law	**13**	School
7	Sister-in-law	**14**	Other, specify: …………

K4 Do you know at what age a girl usually starts to menstruate? — **K4** ☐

- **1** Yes → **K5** At what age? → **GO TO K25** — **K5** ☐☐ Yrs
- **2** No → **GO TO K25**

K6 *[Sabalaks only:]* At what age did you menstruate for the first time? — **K6** ☐☐ Yrs

K7 Were you informed about menstruation before it started? — **K7** ☐

- **1** Yes → **K8** By whom or what were you informed? *[first source]* — **K8** ☐☐
- **2** No

1	Mother	**8**	Friend
2	Father	**9**	Health or FP worker
3	Sister	**10**	Doctor
4	Grandmother	**11**	Television/radio
5	Aunt	**12**	Newspaper/magazine
6	Mother-in-law	**13**	School
7	Sister-in-law	**14**	Other, specify: ……………..

K9 In general, do you bleed excessively during your menstruation? — **K9** ☐

- **1** Yes → **K10** How many times does this excessive bleeding occur? — **K10** ☐
  - **1** All the time
  - **2** Sometimes
  - **3** Seldom
  - **8** Not applicable
- **2** No

K11 How many cloths do you need to use then per day? — **K11** ☐☐ No.

K12 How long does your menstruation last in days? — **K12** ☐☐ No.

K13 Is your menstruation in general regular? — **K13** ☐

- **1** Yes, always regular
- **2** Yes, mostly regular
- **3** No, not so regular
- **4** No, very irregular
- **8** Not applicable

K14 How many days were there between your last two menstrual periods? — **K14** Days ☐☐

[Interviewer: help the respondent to count if necessary]

K15 Do you ever experience any pain, discomfort or feelings of distress during these particular days of the month? — **K15** ☐

- **1** Yes → **K16** What causes most pain/discomfort/distress? *[Interviewer: do **not** read out]*
- **2** No → **GO TO K16i**

Headache	**K16a**	☐	Pain in abdomen	**K16e**	☐
Heavy bleeding	**K16b**	☐	Seclusion/shame	**K16f**	☐
Moodiness	**K16c**	☐	General weakness	**K16g**	☐
Irregularity	**K16d**	☐	Other, specify ………	**K16h**	☐

GO TO K16i

K16i Do you think a girl who has had her first menstruation can get pregnant the first time she has sex? **1** Yes **2** No **9** Don't know — **K16i** ☐

Continuation Module K: Reproductive health and development

K16j What is the most likely time of the month that a women can get pregnant? — **K16j** [ ]

1 A week before menstruation
2 A week after menstruation
3 During menstruation
4 About two weeks before the next menstruation
5 Just before the next menstruation begins
6 Timing doesn't matter
9 I don't know

K17 *[For boys:]* At what age were you circumcised? — **K17** [ ][ ] Yrs

K18 At what age did your voice break? — **K18** [ ][ ] Yrs

K18a Have you ever heard of *mashik* or menstruation that girls and women have? — **K18a** [ ]
1 Yes **2** No

K19 Do you experience *swapna dush* or 'night pressure'? — **K19** [ ]
1 Yes → **K20** At what age did this start? — **K20** [ ][ ] Yrs
2 No → **GO TO K25**

K21 Do you or have you ever had a girlfriend? — **K21** [ ]
1 Yes → **GO TO K22**
2 No → **GO TO K22**

K22 *[All adolescents:]* How did you react/feel about this experience, i.e. your first menstrual bleeding (girls)/*swapna dush* (boys)? — **K22** [ ]

1 I was mainly scared
2 I was mainly confused
3 I was mainly surprised
4 Other, specify: ……………
9 I don't remember how I felt

K23 After it happened did you talk about it with someone? *[Interviewer: if respondent talked with more than one person, fill in first person mentioned.]* — **K23** [ ][ ]

1 No, with no one
2 Yes, with my mother
3 Yes, with my father
4 Yes, with my grandmother
5 Yes, with my grandfather
6 Yes, with my brother(s)
7 Yes, with my sister(s)
8 Yes, with friend(s)
9 Yes, with doctor/health provider
10 Yes, other: specify: ……………

K24 Did it bring about the following changes? *[Interviewer: read categories aloud: 1=Yes; 2=No; 8=Not applicable; 9=Don't know]*

a Was not allowed to carry on friendship(s) with boys/girls — **K24a** [ ]
b I stopped taking baths in the river or any open space. — **K24b** [ ]
c I changed the way I used to dress. — **K24c** [ ]
d I stopped sleeping with my father/mother. — **K24d** [ ]
e I stopped going anywhere alone. — **K24e** [ ]
f I started helping my father/mother with his/her daily work. — **K24f** [ ]
g I started to pray regularly every day. — **K24g** [ ]

→ **GO TO K19**

K25 As you become older your body changes. What changes did you notice? *[Interviewer: do **not** read out; tick if mentioned]*

General appearance	**K25a** [ ]	Breast development	**K25f** [ ]
Became taller	**K25b** [ ]	*Mashik*	**K25g** [ ]
Weight gain	**K25c** [ ]	Changes in voice	**K25h** [ ]
Growing pubic hair	**K25d** [ ]	*Swapna dush*	**K25i** [ ]
Acne or pimples	**K25e** [ ]	Other: specify: …………………	**K25j** [ ]

Interviewer: *If one of K25a-j = ticked* → **GO TO K26**
If one of K25a-j = not ticked → **GO TO K29**

K26 At approximately what age did these bodily changes start? — **K26** [ ][ ] Yrs

Continuation Module K: Reproductive health and development

K27 Were you informed about these bodily changes before they started?

1 Yes → **K28** By whom or what were you informed? *[First mentioned]*

2 No → **GO TO K29**

1	Mother	**8**	Friend
2	Father	**9**	Health or FP worker
3	Sister	**10**	Doctor
4	Grandmother	**11**	Television/radio
5	Aunt	**12**	Newspaper/magazine
6	Mother-in-law	**13**	School
7	Sister-in-law	**14**	Other, specify: …………

GO TO K29

K27 ☐
K28 ☐☐

K29 Have you ever heard about one or all of the following diseases?
[Read aloud: 1=Yes; 2=No]

Syphilis	**K29a**	☐
Gonorrhea	**K29b**	☐
HIV/AIDS	**K29c**	☐

If one of K29a-c = '1' (Yes) → **GO TO K30**
If one of K29a-c = '2' (No) → **GO TO Module R**

K30 Do you think a person can be infected by such a disease or virus and not have any physical signs or symptoms?
1 Yes **2** No **9** Don't know

K30 ☐

K31 Do you know what factors or behaviours may increase the risk of infection by diseases such as syphilis, gonorrhea and HIV/AIDS?
*[Do **not** read categories aloud; tick if mentioned]*

a	Receiving an unsafe blood transfusion (not screened)	**K31a**	☐
b	Using public bathrooms	**K31b**	☐
c	Kissing on the mouth	**K31c**	☐
d	Shaking hands	**K31d**	☐
e	Sharing needles	**K31e**	☐
f	Sharing objects with a person who is infected	**K31f**	☐
g	Having a routine medical examination	**K31g**	☐
h	Having a hetrosexual relationship and not using condoms	**K31h**	☐
I	Having a homosexual relationship and not using condoms	**K31i**	☐
j	Going to a brothel and not using a condom	**K31j**	☐
k	Having extramarital sex and not using condoms	**K31k**	☐
l	Have sex with someone of different blood group	**K31l**	☐
m	By bad spirit/evil eye	**K31m**	☐
n	Through breastfeeding	**K31n**	☐
o	From mother to foetus	**K31o**	☐
p	Allah's will	**K31p**	☐
q	Mosquito bites	**K31q**	☐
r	Other, specify: ……………….	**K31r**	☐

K32 What do you think a person can do to reduce the risk of contracting syphilis, gonorrhea or HIV/AIDS? *[Do **not** read categories aloud; tick if mentioned]*

a	Use condoms	**K32a**	☐
b	Do not have unsafe sex with a prostitute	**K32b**	☐
c	Have only one sexual partner	**K32c**	☐
d	Do not have sexual relationships at all	**K32d**	☐
e	Sterilise needles before using them	**K32e**	☐
f	Don't know	**K32f**	☐
g	Other, specify: ……………….	**K32g**	☐

→ **GO TO Module S**

Module S: Social life

S1 We would like to ask you about your knowledge of government regulations and laws regarding marriage and property in Bangladesh. Are the following statements True or Not true. *[1=True; 2=Not true; 9=Don't know]*

- **a** The law in Bangladesh says that the family of the bride must pay a dowry to the groom's family when they marry. — **S1a** ☐
- **b** The law in Bangladesh says that a man can take another wife without the permission of his current wife/wives. — **S1b** ☐
- **c** The law in Bangladesh says that a girl must be at least 18 years old before she can get married. — **S1c** ☐
- **d** The law in Bangladesh says that divorce can take place only after a government court has given permission for the divorce. — **S1d** ☐
- **e** The law in Bangladesh says that all family property can only be inherited by a male child/children. — **S1e** ☐
- **f** Whether a newborn is a boy or a girl is determined by the mother. — **S1f** ☐

S2 We would like to ask your opinion about some statements. Can you tell whether you agree or disagree with the following: *[Interviewer: 1= Agree; 2=Disagree; 9=Don't know/ Neither agree nor disagree]*

- **a** Parents know best whom their daughter/son should marry. — **S2a** ☐
- **b** Parents know best when their daughter/son is ready to get married. — **S2b** ☐
- **c** A 15-year-old girl can have a friendship with an 18-year-old boy. — **S2c** ☐
- **d** The most important characteristic of a wife/husband-to-be is her/his physical appearance: she/he must look beautiful/handsome. — **S2d** ☐
- **e** If an unmarried girl has a job, this will affect, namely lower, her dowry. — **Sde** ☐
- **f** A daughter must start working at an early age, even if that means that she can no longer attend school. — **S2g** ☐
- **g** A son must start working at an early age, even if that means that he can no longer attend school. — **S2f** ☐
- **h** A woman can be as good a UP chairman as a man. — **S2h** ☐

S3 From the following statements, we would like you to indicate whether you totally agree/agree/neither agree nor disagree/disagree/completely disagree *[Interviewer: Read categories aloud:1=totally agree;2=agree;3=neither agree nor disgree; 4=disagree; 5=disagree completely]*

- **a** At times I think I am no good at all — **S3a** ☐
- **b** I take a positive view of myself — **S3b** ☐
- **c** All in all, I am inclined to feel that I am a failure — **S3c** ☐
- **d** I wish I could have more respect for myself — **S3d** ☐
- **e** I feel that I am a person of worth, at least on an equal plane with others — **S3e** ☐
- **f** On the whole, I am satisfied with myself — **S3f** ☐
- **g** I feel I do not have much to be proud of — **S3g** ☐
- **h** I feel that I have a number of good qualities — **S3h** ☐
- **I** I am able to do things as well as most people — **S3i** ☐
- **j** I certainly feel useless at times — **S3j** ☐

S4 What do ***you*** think is the best age to get married?

Years

- **a** For girls at the age of … — **S4a** ☐☐
- **b** For boys at the age of … — **S4b** ☐☐

What do ***you*** think is the best age to become a mother/ father?

Years

- **c** For girls the best age to have a child is … — **S4c** ☐☐
- **d** For boys the best age to become a father is … — **S4d** ☐☐

Continuation Module S: Social life

S5 Do you know of any problems that can happen if girl gets pregnant before she is eighteen years old? **S5** ☐

1 Yes → **S6** What problems? *[Do **not** read out; tick if mentioned]*

2 No ↓

a	Give birth to weak baby	**S6a** ☐
b	Baby can die while being born	**S6b** ☐
c	Difficult labour and childbirth for mother	**S6c** ☐
d	Mother may die while giving birth	**S6d** ☐
e	Not enough money to raise child/family becomes poorer	**S6e** ☐
f	Population problem	**S6f** ☐
g	Not ready for family responsibility	**S6g** ☐
h	Having to quit school/dropping out of school	**S6h** ☐
I	Infertility	**S6i** ☐
j	Other, specify: …………………………………………..	**S6j** ☐

S7 Are you involved in any of the following organised activities in or outside school? *[Interviewer: Read categories aloud: 1=Yes; 2=No]*

Health group	**S7a** ☐	BRAC committee	**S7f** ☐
Boy scouts/girl guides	**S7b** ☐	Political group	**S7g** ☐
Local youth club	**S7c** ☐	Credit group	**S7h** ☐
Sports club	**S7d** ☐	Religious group	**S7i** ☐
Music/dance/theatre	**S7e** ☐		

S8 How many friends do you currently have in total? **S8** ☐☐ No.

S9 Among all your friends, how many are of the opposite sex? **S9** ☐☐ No.

S10 What do you mainly do when your are angry? *[Read aloud; main reason]* **S10** ☐

1 Yell or shout at my mother
2 Yell or shout at my father
3 Take it out on brother(s)/sister(s)
4 Yell or shout at my friend(s)
5 Keep quiet and act as normal
6 Run away from home to be alone
7 Go to other family members
8 Go to friend(s)
9 Other, specify …………………

S11 What do you do when you have a problem or in moments of distress? **S11** ☐

1 Go to my mother
2 Go to my father
3 Go to brother(s) or sister(s)
4 Go to other family member
5 Don't do anything/wait till it is over
6 Solve it myself
7 Go to friend(s)
8 Never have a problem
9 Other, specify: ……………

S12 How would you rate your life as compared to that of your peers: is your life better, worse or about the same as theirs? **S12** ☐

1 Better **2** Worse **3** Same

S13 Do you ever watch television? If so, approximately how often? **S13** ☐

1 No, never
2 Yes, (at least) once per day
3 Yes, once per week
4 Yes, once per month
5 Yes, a few times per year

S14 Do you go to the cinema to see a movie? If so, approximately how often? **S14** ☐

1 No, never
2 Yes, (at least) once per day
3 Yes, once per week
4 Yes, once per month
5 Yes, a few times per year

S15 Do you ever listen to the radio? If so, approximately how often? **S15** ☐

1 No, never
2 Yes, (at least) once per day
3 Yes, once per week
4 Yes, once per month
5 Yes, a few times per year

S16 Do you read newspapers or magazines? If so, approximately how often? **S16** ☐

1 No, never
2 Yes, (at least) once per day
3 Yes, once per week
4 Yes, once per month
5 Yes, a few times per year

→ **GO TO Module X**

Module X: Anthropometric measurements

Name (see Cover page)	X1	X2	X3	X4	X5	X6	X7
Name: Start with the adolescent. Then, if possible, the biological father and mother.	DSS-RID number DSS-CID number	Height in cm, mm	Reason why no height was taken	Weight in kg, grams *[Measure 2x 2nd time at different spot]*	Reason why no weight was taken	Mid-upper arm circumference measurement in mm.	Reason why no MUAC was taken
……………………… 1 ……………………… 2		,		, ,			
……………………… 1 ……………………… 2		,		, ,			
……………………… 1 ……………………… 2		,		, ,			
……………………… 1 ……………………… 2		,		, ,			
……………………… 1 ……………………… 2		,		, ,			

Codes for X3, X5, and X7:

1 Unavailable
2 Sick
3 Died
4 Pregnant
5 Mother doesn't allow
6 Father doesn't allow
7 Husband doesn't allow
8 Mother-in-law doesn't allow
9 Father-in-law doesn't allow
10 Other, specify ……………………

This is the end of the questionnaire. Thank the respondent(s) for the interview. Do not forget to record the time of completion of the interview on the cover page.

Module Z: Evaluation form

[To be filled in by the Interviewer. Please report anything about the interview that was unusual. Also report if you think the state of mind or attitude of the respondent was unusual as this might have affected his or her responses.]

Z1 Who else (other than the adolescent respondent) was present during the interview? *[Interviewer:tick if present]*

a	No one	**Z1a** ☐
b	His wife/her husband	**Z1b** ☐
c	His/her father	**Z1c** ☐
d	His/her mother	**Z1d** ☐
e	One or more children younger than five years	**Z1e** ☐
f	One or more children of five years and older	**Z1f** ☐
g	One or more brothers	**Z1g** ☐
h	One or more sisters	**Z1h** ☐
I	Another family member	**Z1i** ☐
j	His/her father-in-law	**Z1j** ☐
k	His/her mother-in-law	**Z1k** ☐
l	Other family-in-laws	**Z1l** ☐
m	Someone else, specify: …………………………………………………….....	**Zm** ☐

Z2 Which of the following best describes the respondent's attutide during the interview? **Z2** ☐

1 Very helpful
2 Somewhat helpful
3 Neutral
4 Somewhat hostile
5 Very hostile

Z3 How would you describe the respondent's interest in the interview? **Z3** ☐

1 Very interested
2 Somewhat interested
3 Neutral
4 Not very interested
5 Disinterested

Z4 Did the respondent ask any questions about the survey? **Z4** ☐

1 Yes → **Z5** What question(s) did the respondent ask?
……………………………………………………………
……………………………………………………………
……………………………………………………………
……………………………………………………………
……………………………………………………………
……………………………………………………………

2 No

Z6 If the interview was prematurely terminated, please describe the situation:
………………………………………………………………………………………
………………………………………………………………………………………
………………………………………………………………………………………
………………………………………………………………………………………
………………………………………………………………………………………
………………………………………………………………………………………

Return to cover page and fill in TIME FINISHED & RESULT CODE of interview

Annex to questionnaire for follow-up survey

Occupations

1	No (2nd) occupation	27	Bus driver
2	Student	28	Typist
3	Housewife	29	Office worker
4	House labourer	30	Policeman/army man
5	Farmer	31	Gypsy
6	Agricultural labourer	32	Traditional healer
7	Mill owner	33	Doctor
8	Mill worker	34	Midwife
9	(Small) businessman	35	Health worker
10	Teacher	36	Pharmacist
11	Garment worker	37	Butcher
12	Weaver	38	Shoemaker
13	Tailor	39	Carpenter
14	Handicraftsman	40	Cook
15	Security guard	41	Blacksmith
16	Cargo worker	42	Working abroad
17	Factory worker	43	Beggar
18	Washerman/washerwoman	44	Member of development programme/credit group
19	Boatman	45	Salesman
20	Mechanician of cars	46	Lawyer
21	Electrician	47	Engineer
22	Bookkeeper	48	Goldsmith (jewellery)
23	Home-tutor	49	Construction worker
24	Fisherman	50	*Moulana* (preacher of Islam/teacher at *madrasha*)
25	Riksja-puller	51	Mechanician of radios and televisions
26	Baby-taxi driver	99	Don’t know/no preference

School types

1	Secular
2	Madrasha
3	Maktab
4	Hafezee
5	Not applicable
9	Don’t know

Appendix D: Selected topics for in-depth interviews

General information

- Age, name, sex, marital status, village, RID and CID number
- Household composition (see HDSS form)
- Educational level and occupation (if applicable)

Topics for unmarried adolescent girls

Concept of adolescence

- Birth, childhood … what comes next?
- When do you no longer consider yourself (for parents: your daughter/son) a child? What are the signs?
- What are the changes in your (for parents: daughter's/son's) life, for instance regarding school, relationship with others, physical development?

Menarche & menstruation

- What were the circumstances at the moment you had your first menstruation?
- How did you feel?
- Were you informed about menarche before it started? If yes, by whom or what?
- Did you talk about menarche with others? If yes, with whom did you discuss it?
- Do you talk about menstruation in general with others?
- Does your mother (for mothers: your daughter) know when you are menstruating?
- Do you use any special 'codes' for menstruation?
- Do you observe any special behaviours or practices on those days?
- How do you perceive menstruation: positively or negatively? And why?
- How do you feel on those days?
- Do you know why a girl/woman menstruates? Can you explain the physical process?

Sexual knowledge & opinions

- How long does a full-term pregnancy last? How do women count the duration of a pregnancy? By whom or what were you informed?
- Do you think all information is correct? Do you have questions or would you like to know more? If yes, about which topics?
- Do you talk about contraception with other people? If yes, with whom?
- What do you think about contraception after marriage? Is it in line with Islam?
- What do you think about sex before marriage?
- Are there any differences in social acceptance between boys and girls in this respect?
- Do you think abortion is acceptable? If not, why? If yes, under what circumstances? Did you ever have an abortion or know someone who had an abortion? Under what circumstances was it performed?

Matchmaking & dowry

- How does menarche in your view relate to marriage?
- When do you think a girl is ready for marriage? What age do you consider 'early' and what age do you consider 'late' in this respect?

- Who decides about your future marriage/who decided about your marriage? What other family members are/were involved?
- At what stage is an adolescent girl (bride) and boy (groom) informed/were you informed about the marriage? What factors are/were taken into account?
- What expectations do you have about a future husband/wife (for parents: for your daughter/son)?
- What are your views about dowry? Is there going to be a dowry for your future marriage/was there a dowry when you married? If yes, what is the approximate value? And how do/did you and your family arrange the money? If no, why will there be/was there no dowry? Will this/did this affect the marriage? What is/was the role of others in this respect?

Topics for married adolescent girls

Concept of adolescence (*see topics for unmarried adolescent girls*)
Menarche & menstruation (*see topics for unmarried adolescent girls*)
Sexual knowledge & opinions (*see topics for unmarried adolescent girls*)
Matchmaking & dowry (*see topics for unmarried adolescent girls*)
Extra: own marriage experiences

- What do you prefer: love marriages or arranged marriages? And why? What type of marriage was yours?
- What is the age gap between you and your husband (for fathers: wife)? What do you think of this?
- When were you informed that you would be married?
- Did you or your spouse have any sexual experience before your marriage?
- Are you (for fathers: you or your wife) currently using any contraceptives or have you been using them? If yes, why and who decided on this? If not, why not?

Topics for adolescent boys

Concept of adolescence (*see topics for unmarried adolescent girls*)
Sexual knowledge & opinions (*see topics for unmarried adolescent girls*)
Matchmaking & dowry (*see topics for unmarried adolescent girls*)
Extra: spermarche

- What were the circumstances at the time you reached spermarche?
- How did you feel? Were you informed before it started? If yes, by whom or what?
- Did you talk about it with others? If yes, with whom did you discuss it?
- Do you talk about spermarche in general with others?
- Do you use any special ‘codes’ for it?
- How do you perceive it: positively or negatively? And why?
- Do you know why boys have spermarche? Can you explain the physical process?

Topics for mothers of adolescents

Concept of adolescence (*see topics for unmarried adolescent girls*)
Menarche & menstruation (*see topics for unmarried adolescent girls*)
Sexual knowledge & opinions (*see topics for unmarried adolescent girls*)

Matchmaking & dowry (*see topics for unmarried adolescent girls*)
Extra: own marriage experiences (*see topics for married adolescent girls*)
Extra: early marriage and childbirth

- What were your own experiences regarding marriage and childbirth (for fathers: your wife's delivery)?
- At what ages did you and your spouse marry and when did you (for fathers: your wife) became pregnant?
- Did you (for fathers: your wife) experience any problems during the early stages of your marriage or with regard to the first pregnancy and/or delivery?
- Do you think your own (for fathers: your wife's) experiences in marriage and childbirth influence the way you now think about the timing of the (future) marriage of your daughter or son? Is yes, in what respect?

Topics for fathers of adolescents

Concept of adolescence (*see topics for unmarried adolescent girls*)
Sexual knowledge & opinions (*see topics for unmarried adolescent girls*)
Matchmaking & dowry (*see topics for unmarried adolescent girls*)
Extra: own marriage experiences (*see topics for married adolescent girls*)
Extra: early marriage and childbirth (*see topics for mothers of adolescents*)

Topics for *ghatoks* (matchmakers)

Matchmaking process

- Can you describe the process of matchmaking in general?
- What is the duration of such a process?
- What factors do you and your clients take into account?
- Who are your clients?
- From which area do they come?
- What do you charge for arranging a marriage?

Topics for Family Welfare Visitor

Concept of adolescence (*see topics for unmarried adolescent girls*)
Extra: experiences of the Centre

- What are the aims of your Centre?
- How many adolescents come to your Centre (per month)?
- Boys and girls?
- For what reasons do they come?
- Do you also provide services on contraception, menstrual regulation and abortion?
- What do you charge for your services?

Summary in Dutch

Inleiding

In deze studie staat de reproductieve gezondheid van adolescenten in Matlab, een ruraal gebied in Bangladesh, centraal. Adolescentie is één van de meest intense periodes in het leven waarin een kind in zowel lichamelijk als mentaal en emotioneel opzicht volop in ontwikkeling is. In Bangladesh is het ook in demografisch opzicht een belangrijke periode omdat veel meisjes relatief snel na hun menarche, de eerste menstruatie, worden uitgehuwelijkt en kinderen krijgen (Islam and Mahmud 1995).

Zowel in fysiek als in mentaal opzicht kan reproductieve gezondheid in adolescentie worden gerelateerd aan invloeden uit de kindertijd. In Bangladesh zijn veel kinderen - meisjes vaker dan jongens - in meer of mindere mate ondervoed: 50 procent van de levendgeborenen in Bangladesh heeft een geboortegewicht dat lager is dan 2.500 gram en bijna 60 procent van de kinderen beneden de vijf jaar is ondervoed (Baqui 1990; Ross et al. 1996; ICDDR,B 2002b; WHO 2003). Er zijn sterke aanwijzingen dat een laag geboortegewicht en periodes van ondervoeding daarna, resulteren in een groeiachterstand die niet of nauwelijks is in te halen, vooral als de levensomstandigheden slecht blijven (Gillespie en Flores 2000). Kinderen blijven daardoor relatief klein en bereiken uiteindelijk niet de lengte die ze in betere omstandigheden wel hadden kunnen krijgen. Daarnaast zijn er aanwijzingen dat deze groeivertraging ook van invloed kan zijn op de reproductieve gezondheid later in het leven. Zo bleek uit ander onderzoek dat in een groep Bengaalse meisjes de eerste menstruatie gemiddeld bijna drie jaar later plaats vond dan in een groep Britse meisjes (15,8 respectievelijk 12,5 jaar) (Riley 1987). Recentelijk wordt verondersteld dat het moment van menarche, naast (een vermoedelijk kleine) genetische predispositie, mogelijk al wordt 'geprogrammeerd' in utero of na de geboorte en dat dit moment vervolgens wordt beïnvloed door veranderingen in antropometrie gedurende de kindertijd (Gray 1993; Silva et al. 2003; Rich-Edwards 2002). De associatie met voedingsstatus eerder in het leven is echter, zeker in ontwikkelingslanden, door het ontbreken van de benodigde longitudinale data niet of nog nauwelijks onderzocht.

Ook mentale of emotionele ontwikkelingsprocessen beïnvloeden de reproductieve gezondheid van adolescenten. Deze opvatting stoelt op de gedachte dat deze processen zich ook voltrekken volgens het *epigenetische* principe (ontwikkeling betreft een systematische ontvouwing van een 'basisplan' waarbij verschillende fasen kunnen worden onderscheiden). In dit onderzoek wordt een verwijzing gemaakt naar de theorie over psychosociale ontwikkeling van Erikson (1963; Zimbardo et al. 1993), waarin het al dan niet bereiken van *developmental readiness* in de adolescentieperiode wordt gerelateerd aan de manier waarop de vroege en late kindertijd is doorlopen. Midden jaren '80 schetsten Aziz en Maloney (1985) een beeld van de verschillende ontwikkelingsfases die in Matlab vóór en gedurende de adolescentieperiode kunnen worden onderscheiden: *sisukal* (peuter- en kleutertijd/vroege kindertijd), *balyakal* (late kindertijd), *kaisorer prarambha* (pre-adolescentie), *kaisor* (vroege adolescentie) en *nabajaubon* (late adolescentie). Uit de schets van Aziz en Maloney, aangevuld met inzichten uit meer recente studies, blijkt dat meisjes in Matlab (en Bangladesh in het algemeen) op een andere manier worden grootgebracht dan jongens, in het bijzonder wanneer het gaat om reproductieve en familiale zaken (Aziz en Maloney 1985; Blanchet 1994; 1996; White 1992; Ross 1996). Deze verschillen in genderspecifieke verwachtingspatronen vormen in onze studie het kader waarbinnen het kennisniveau en de percepties van adolescenten op het gebied van reproductieve ontwikkeling is bestudeerd.

Deze studie is uitgevoerd binnen het onderzoeksprogramma HERA (*HEalthy reproduction: Research for Action*; een collaboratie tussen het Population Research Centre van de Rijksuniversiteit Groningen en het Nederlands Interdisciplinair Demografisch Instituut) in samenwerking met het ICDDR,B (het Centre for Health and Population Research, het vroegere *International Centre for Diarrhoeal Disease Research, Bangladesh*). De studie is grotendeels gefinancierd met een beurs van WOTRO, de Stichting voor Wetenschappelijk Onderzoek van de Tropen, dat ressorteert onder NWO, de Nederlandse Organisatie voor Wetenschappelijk Onderzoek, en kon worden voltooid dankzij bijdragen van het NIDI en HERA.

Achtergronden: twee paradigmaverschuivingen

Twee relatief recente belangrijke paradigmaverschuivingen zijn belangrijk om te noemen met betrekking tot de theoretische achtergrond van deze studie. Ten eerste de verschuiving in ‘denken’ ten aanzien van reproductieve gezondheid, welke gestalte kreeg in Caïro, in 1994, op de *International Conference on Population and Development* (ICPD). Op deze conferentie werd afgesproken dat reproductieve gezondheid een *recht* is. Tevens werd benadrukt dat ook *adolescenten* aanspraak kunnen maken op het recht om een goede reproductieve gezondheid te bewerkstellingen en te handhaven (ICPD 1994). Dit lag, en ligt, in veel landen gevoelig omdat daarmee expliciet wordt erkend dat adolescenten, ongeacht hun huwelijkse status, ‘reproductieve individuen’ zijn en dat ze, gezien hun leeftijd, mogelijk specifieke behoeften hebben op dit gebied.

Enkele jaren vóór de ICPD vond in wetenschappelijke kringen een andere paradigmaverschuiving plaats. Deze verandering betrof een verschuiving van het denken in termen van ‘leefstijl’ naar ‘levensloop’, waarbij vooral het belang van de periode tijdens gestatie (de periode van zwangerschap) en de eerste levensjaren centraal kwam te staan (zie bijvoorbeeld Barker 1992). Barker, een epidemioloog, formuleerde de hypothese - de *foetal origin of disease hypothesis* - waarin wordt gesteld dat de manier waarop iemands metabolische en cardiovasculaire systeem zich ontwikkelt tijdens de zwangerschap en de eerste levensjaren (de zogenaamde ‘kritische periode’) van blijvende invloed is op het lichamelijk functioneren later in het leven (Robinson 1992). De achterliggende gedachte is dat de ontwikkeling van deze primaire systemen wordt aangepast aan bepaalde omgevingsfactoren (bijvoorbeeld onvoldoende of inadequate voedingsinname van de moeder tijdens de zwangerschap) en dat wanneer omgevingsfactoren later in het leven anders zijn (bijvoorbeeld leven in een omgeving van overvloed waarbij voldoende voeding is) het lichaam niet op deze veranderingen is ingesteld (het is anders ‘geprogrammeerd’) waardoor de kans op bepaalde chronische ziekten toeneemt (Pojda en Kelley 2000).

Een alternatief verklaringsmodel betreft dat van de ‘cumulatieve causatie’ dat focust op de opeenvolging van ervaringen en condities die elkaar in de loop van tijd beïnvloeden en daardoor uiteindelijk kunnen leiden tot een verandering - positief of negatief - van de kans dat een bepaalde conditie of gebeurtenis (bijvoorbeeld ziekte) in de toekomst zal optreden (Kuh en Ben-Schlomo 1997). In dit onderzoek wordt gerefereerd aan het model van de *intergenerational cycle of growth failure* waaraan zowel het mechanisme van *programmeren* als dat van *cumulatieve voedingsdeprivatie* ten grondslag ligt (United Nations 2000).

Doel van het onderzoek

Deze studie adopteert een 'levensloop' benadering en heeft als doel om de *reproductieve gezondheidsstatus* van 12- tot 16-jarige *adolescenten* in Matlab, Bangladesh, te bestuderen in relatie tot hun contemporaine voedingsstatus en hun voedingsstatus in de *vroege kindertijd*, dat wil zeggen toen ze tussen de nul en vijf jaar oud waren. De levensloop kan ook worden omschreven als een stelsel van samenhangende carrières of loopbanen. In deze studie staan de reproductieve gezondheidsloopbaan en de voedingsstatusloopbaan van adolescenten centraal. Een *intergenerationeel* perspectief is aan de studie toegevoegd door ook gegevens van de moeders van de adolescenten in de analyse mee te nemen.

Definities en operationalisatie

De definitie van *reproductieve gezondheid van adolescenten* die wij hanteren is gebaseerd op de algemene definitie van *reproductieve gezondheid* zoals geformuleerd in het actieprogramma dat is overeengekomen op bovengenoemde ICPD (1994). Wij onderscheiden enerzijds *fysiek* en anderzijds *mentaal en emotioneel welbevinden* met betrekking tot reproductief functioneren. De eerste belangrijke *fysieke* gebeurtenis die betrekking heeft op reproductief functioneren betreft het tijdstip van de eerste menstruatie bij meisjes (menarche) en de eerste zaadlozing bij jongens (spermarche) (WHO 1995). Voedingsstatus, de belangrijkste determinant, is in deze studie geoperationaliseerd door middel van antropometrische maten, zoals gewicht, lengte, omtrek van de bovenarm, en de Body Mass Index (BMI). *Mentaal en emotioneel welbevinden* op reproductief gebied wordt in deze studie geoperationaliseerd door in kaart te brengen wat het kennisniveau en de percepties van adolescenten zijn ten aanzien van reproductieve gezondheid en reproductieve ontwikkeling.

Opzet van onderzoek

Het bestuderen van de reproductieve gezondheid van adolescenten vanuit een *levensloopperspectief* is alleen mogelijk met behulp van *longitudinale* data, dat wil zeggen informatie over dezelfde personen verzameld op meer dan één moment, zodat kan worden onderzocht hoe het iemand is vergaan tussen tijdstip t en t+x. In dit onderzoek zijn t en t+x respectievelijk de jaren 1988-1989 (*baseline*) en 2001 (*follow-up*). In 1988-1989 heeft Dr. Baqui, een kinderarts die is gelieerd aan het ICDDR,B, een onderzoek uitgevoerd onder 707 Bengaalse kinderen van nul tot vijf jaar naar het vóórkomen en de oorzaken van diarree, waaronder ernstige varianten zoals cholera (Baqui 1990). Wij hebben deze kinderen 13 jaar later, in 2001, weer opgezocht en geïnterviewd in het kader van de huidige studie.

Het opvolgen van een dergelijke populatie werd mogelijk gemaakt doordat de studie van Dr. Baqui was gesitueerd in drie dorpen (*Charmasua*, *Saidkharkandi* en *Baluchar*) die allen in *Matlab* liggen. ICDDR,B onderhoudt in Matlab een cholera-veldziekenhuis van waar uit allerlei, veelal medische, onderzoeken worden uitgevoerd. Het langstlopende onderzoek (sinds 1966) betreft het zogenaamde *Health and Demographic Surveillance System* (HDSS) dat in 142 dorpen operationeel is (Ross et al. 1996). Iedere inwoner uit Matlab heeft een HDSS-persoonsnummer en elke maand verzamelen veldwerkers van iedereen gegevens over onder andere geboorte, sterfte, migratie en huwelijk. Deze informatie wordt opgeslagen en periodiek geanalyseerd waardoor in de loop van jaren een goed beeld is ontstaan hoe de bevolking in Matlab zich heeft ontwikkeld. De drie studiedorpen zijn in veel opzichten onderling vergelijkbaar. De bewoners leven veelal van de visserij, zijn werkzaam in de landbouw of hebben kleine bedrijfjes. Omdat de HDSS-databestanden geen informatie bevatten over de voedingsstatus van de bewoners is besloten om de studie van Dr. Baqui als uitgangspunt te nemen voor onze *longitudinale* studie. In 2001 waren de kinderen die Dr. Baqui in 1988-1989 had onderzocht inmiddels tussen de 12 tot 16 jaar oud. Het interview dat wij onder deze adolescenten hebben afgenomen had betrekking op het tijdstip van reproductieve transities (menarche, spermarche), lichamelijke ontwikkeling, kennis van seksualiteit en reproductieve zaken, en verwachtingen ten aanzien van hun eigen reproductieve leven. Tevens zijn antropometrische maten genomen om inzicht te verkrijgen in hun voedingsstatus. Daarnaast zijn enkele vragen gesteld aan de (biologische) moeders van de adolescenten en is ook hun antropometrie bepaald.

Naast de follow-up survey is door middel van diepte-interviews additionele informatie verzameld. Deze diepte-interviews zijn gehouden onder een selecte groep van 28 individuen, van wie de meesten ongetrouwde adolescente jongens en meisjes, enkele getrouwde adolescente meisjes, een paar moeders en vaders van adolescenten, twee *ghatok*s ofwel huwelijksmakelaars die in de onderzoeksdorpen actief zijn, en één jeugdwelzijnswerker.

De gekoppelde databestanden (1988-1989 en 2001) zijn geanalyseerd aan de hand van beschrijvende statistische methoden en binaire logistische regressietechnieken. Het schatten van de leeftijd waarop de meisjes in onze populatie beginnen te menstrueren, in samenhang met hun voedingsstatus, is gebeurd met behulp van sterftetafels (*lifetables*) en het Cox-regressiemodel. Bestudering van het mentaal-emotioneel welzijn van adolescenten met betrekking tot reproductieve gezondheid is gebeurd door middel van beschrijvende statistische methoden en het analyseren van de informatie verzameld in de diepte-interviews.

Uitval ten gevolge van sterfte en migratie

Volgens de meeste recente HDSS-gegevens waren er van de 707 kinderen die zijn onderzocht in 1988-1989 nog 569 (307 jongens en 262 meisjes) woonachtig in hetzelfde onderzoeksgebied, Matlab, in 2001. De overige kinderen waren óf overleden óf gemigreerd naar een plaats buiten Matlab en vielen daardoor buiten het *surveillance* gebied van ICDDR,B waardoor ze ook voor ons niet meer waren te traceren. ICDDR,B registreert in het HDSS zowel de *out-date* (datum van vertrek uit de Matlab tengevolge van migratie of datum van overlijden) en indien mogelijk ook de *out-cause* (reden van vertrek of doodsoorzaak). Het aantal kinderen dat tussentijds was overleden betrof tien procent, hetgeen iets lager bleek te zijn dan op grond van sterftestatistieken in Matlab mocht worden verwacht (ICDDR,B 2002a). Dit lagere cijfer wordt mogelijk echter ook veroorzaakt doordat ruim 65 procent van de kleine kinderen die in 1988-1989 zijn onderzocht het meest risicovolle jaar (te weten, het eerste levensjaar) toen al achter de rug hadden. De uitval tengevolge van migratie (de overige 90 procent) betrof veelal migratie naar de hoofdstad.

De data van de kinderen die in de periode tussen de *baseline* en de *follow-up survey* waren overleden c.q. gemigreerd, zijn ten behoeve van dit onderzoek teruggekoppeld aan de baseline gegevens. Op deze wijze was het mogelijk om de vraag te beantwoorden in hoeverre deze specifieke groep kinderen verschilt van de overige kinderen die *wel* tot in hun adolescentieperiode zijn opgevolgd. Uit de analyse bleek dat op het moment van *baseline* er geen verschillen van betekenis waren wat betreft demografische en socio-economische omstandigheden tussen de groep ‘uitvallers’ en de ‘blijvers’. Wel was er een verschil in voedingstatus tussen de groep ‘blijvers’ en de groep kinderen die vóórtijdig (dat wil zeggen vóór aanvang van de follow-up survey) zou komen te overlijden. Echter, omdat deze laatste groep een zeer klein aantal kinderen betrof, kunnen er met betrekking tot dit verschil geen conclusies worden getrokken.

Resultaten

Van de 569 adolescenten die nog wel in Matlab woonachtig waren is ruim 84 procent geïnterviewd. Van de meisjesadolescenten bleek 3 procent getrouwd te zijn, hetgeen minder was dan wat op grond van de meest recente huwelijksstatistieken uit Matlab mocht worden verwacht (ICDDR,B 2001). Uit de *kwantitatieve* analyse bleek dat het aandeel (ongetrouwde) adolescente meisjes dat reeds had gemenstrueerd toenam van 7 procent onder de 12-jarigen tot 81 procent onder de 16-jaringen. Meer dan de helft, 52 procent, van alle postmenarche meisjes was 14 jaar of ouder op het moment van menarche. Analyse op grond van sterftetafels, waarbij de gegevens van zowel postmenarche als ook premenarche meisjes werden meegenomen, leverde een geschatte mediane leeftijd van menarche op van 15,1 jaar. De positieve correlatie tussen leeftijd van eerste menstruatie van de moeder en die van haar dochter, zoals aangetroffen in enkele andere studies, werd door onze data niet bevestigd. Echter, hierbij moet worden opgemerkt dat de kwaliteit van de gegevens over de eerste menstruatie van de moeders beperkt is omdat ook deze in 2001 (retrospectief) zijn verzameld.

De voedingsstatus van adolescenten, uitgedrukt in termen van lengte en gewicht (sekse- en leeftijdsspecifiek), bleek slecht te zijn. Maar liefst 66 procent van de jongens- en 46 procent van de meisjesadolescenten had een veel te lage ‘gewicht-voor-leeftijd ratio’ (*underweight*) en 36 procent van de jongens en 28 procent van de meisjes had een veel te lage ‘lengte-voor-leeftijd ratio’ (*stunting*). Er was sprake van een significante relatie tussen het niveau van *stunting* gedurende de adolescentieperiode en dat in de vroege kindertijd. Bijvoorbeeld, van de jongens en meisjes die ernstig *stunted* (te klein voor hun leeftijd) waren als kind is respectievelijk 71 en 56 procent eveneens ernstig *stunted* in adolescentie. Uit regressieanalyse bleek dat het risico van stunting (gemeten in termen van de verhouding tussen de kans op ernstige stunting versus de afwezigheid van stunting) 7,4 keer zo groot is voor adolescenten die ook als kind *stunted* waren als voor adolescenten die als kind *not stunted* waren. Alhoewel de leeftijd van de eerste menstruatie van een adolescent meisje een samenhang vertoonde met zowel haar lengte als haar gewicht, bleek het niveau van *stunting* in adolescentie - hetgeen dus sterk samenhangt met dat in de kindertijd - uiteindelijk de belangrijkste determinant te zijn. Dit betekent dat de leeftijd waarop de eerste menstruatie plaatsvindt het hoogst is voor meisjes die het ergst *stunted* zijn in de adolescentieperiode.

Ook de reproductieve gezondheidsstatus van adolescenten beschouwd vanuit een mentaal-emotioneel perspectief bleek laag te zijn. Een groot deel van de postmenarche meisjes (64 procent) was bang toen de eerste menstruatie zich voordeed, hetgeen mogelijk samenhangt met het ontbreken van voorlichting vóór deze gebeurtenis. Ook onder jongens bleek weinig kennis aanwezig te zijn over reproductieve ontwikkelingsprocessen. De kennis ten aanzien van seksualiteit werd door adolescente jongens zowel als meisjes vaak hoger ingeschat dan het geval bleek te zijn. Vooral de feitelijke kennis op het gebied van voortplanting, contraceptie en HIV/AIDS bleek laag te zijn. Zo wist 41 procent van de jongens en 51 procent van de meisjes geen enkele risicofactor te noemen met betrekking tot de transmissie van het HIV-virus. Adolescenten hadden veel vragen met betrekking tot reproductieve gezondheid en ontwikkeling. Het netwerk van jongens om zaken aangaande hun reproductieve gezondheid te bespreken bleek beperkt: veel jongens praten er helemaal niet over, of enkel met vrienden. Meisjes daarentegen kunnen terugvallen op een veel breder netwerk (vriendinnen, tantes, zussen, moeder, grootmoeder).

Conclusie

Centraal in deze studie staat de vraag wat de reproductieve gezondheidsstatus van adolescenten - meisjes en jongens - in Matlab is en in hoeverre deze status wordt beïnvloed door de contemporaine voedingsstatus en de voedingsstatus in de vroege kindertijd. Op grond van de resultaten is de conclusie getrokken dat de reproductieve gezondheidsstatus van adolescenten in Matlab, zowel met betrekking tot fysiek welbevinden als ook voor wat betreft mentaal-emotioneel welbevinden ten aanzien van reproductief functioneren, laag is, en dat dit mede - indirect - het gevolg is van ondervoeding in de vroege kindertijd. Deze conclusie is gebaseerd op de bevinding dat:

- de leeftijd van menarche hoog is ten gevolge van het relatief vaak vóórkomen van ondervoeding tijdens de adolescentieperiode;
- er een sterke correlatie is tussen een lage voedingsstatus (vooral wat betreft lengte) in de vroege kindertijd en in adolescentie;
- de reproductieve transities door adolescenten relatief vaak ‘negatief’ worden gepercipieerd, dat wil zeggen in onwetendheid en/of angst, zonder vóóraf te zijn voorgelicht, en dat ook het algehele kennisniveau over reproductieve ontwikkeling en aspecten van reproductieve gezondheid (fysiologie van menstruatie, voortplanting, contraceptie, en HIV/AIDS) van de meerderheid van de adolescenten als onvoldoende kan worden beschouwd.

Aanbevelingen ten aanzien van beleid, interventies en vervolgonderzoek

De leeftijd waarop een meisje begint te menstrueren wordt niet zelden als ‘gegeven’ beschouwd. In deze studie concluderen we echter dat een ‘late’ eerste menstruatie, bijvoorbeeld op een leeftijd van 14 jaar of ouder, grotendeels het gevolg lijkt te zijn van ondervoeding, vooral in de eerste levensjaren. Vooral een te lage ‘lengte-voor-leeftijd ratio’ lijkt zeer bepalend te zijn voor de leeftijd waarop deze transitie plaatsvindt. De meisjes die te klein zijn voor hun leeftijd en die aan het begin van de adolescentieperiode staan, kunnen niet of nauwelijks hun groeiachterstand inhalen. Echter, voor meisjes die de adolescentieperiode nog niet hebben bereikt, in het bijzonder meisjes tussen de 6 en 12 jaar (een groep die vaak wordt onderbelicht), is het misschien nog mogelijk om hun groeiachterstand, opgelopen in de eerste levensjaren, in meerdere of mindere mate in te halen, vooral als de leefomstandigheden verbeteren. Dit onderzoek geeft het belang aan van het monitoren van voedingsstatus, in het bijzonder lichaamslengte, vanaf de geboorte tot aan het bereiken van de eerste menstruatie (en het liefst ook daarna) zodat voor voedingsinterventieprogramma’s juist *die* meisjes kunnen worden geselecteerd die de grootste kans lopen om als adolescent ondervoed te zijn waardoor ze ‘laat’ beginnen met menstrueren.

Het belang van de leeftijd bij eerste menstruatie wordt in deze studie besproken door het te bestuderen binnen de sociaal-culturele context van Bangladesh waarbij vooral werd ingegaan op de gemiddeld relatief jonge leeftijd bij eerste huwelijk en bij het krijgen van het eerste kind (Population Reference Bureau 2000). In dit onderzoek is de hypothese geformuleerd dat niet zozeer de *chronologische* leeftijd (leeftijd gemeten in jaren vanaf de geboorte) maar de *gynaecologische* leeftijd (de leeftijd gemeten in jaren vanaf de eerste menstruatie) en de *biologische* leeftijd (de leeftijd passend bij lengte en gewicht) bijdragen aan het welslagen van de eerste zwangerschap en de geboorte van het eerste kind. Momenteel worden een lengte van 145 centimeter en een gewicht van 45 kilo als grenswaarden beschouwd. Bij lagere waarden is sprake van verhoogde obstetrische risico’s (WHO 2003). Een te kleine tijdspanne tussen menarche enerzijds en zwangerschap en geboorte anderzijds zou voor een adolescente moeder-in-spé (en haar kind) verhoogde risico’s met zich mee kunnen brengen, alhoewel het tot op heden nog niet precies duidelijk is hoe een zwangerschap intervenieert met het (reproductieve) groeiproces van het adolescente meisje zelf (Riley et al. 1993). Teneinde te komen tot een verdere specificatie van ‘risicovolle’ zwangerschappen zou kunnen worden onderzocht welk belang moet worden gehecht aan de *gynaecologische* leeftijd (en dus de leeftijd op moment van menarche) en de voedingsstatus, uitgedrukt in lengte en gewicht, bij het al dan niet welslagen van zwangerschappen en geboorten onder meisjes in de tienerleeftijd. In vervolgonderzoek zou bovengenoemde hypothese verder kunnen worden onderzocht.

Wat betreft de ontwikkeling van beleid en interventies kan worden opgemerkt dat - conform de aanbevelingen gedaan op de eerder genoemde ICPD - adolescenten in Bangladesh (momenteel ongeveer 25 procent van de totale bevolking; Population Council 2002) meer kennis over reproductieve ontwikkeling, contraceptiva en de relatie tussen voedingsstatus gedurende de periode tussen geboorte en volwassenheid zouden moeten kunnen verwerven opdat ze, eenmaal getrouwd, bewuste keuzes (*informed choices*) kunnen maken ten aanzien van het krijgen van kinderen. Zeker adolescenten met een ‘risicovolle levensloop’ - gekenmerkt door ondervoeding en een lage *gynaecologische* leeftijd op het moment van trouwen - zouden moeten worden voorgelicht over de mogelijke risico’s voor zwangerschap en geboorte.

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