Infant mortality in Amsterdam around 1850. Religion, social class and space

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Introduction

As in many other mid-nineteenth century towns, indifference of the local government about the high levels of infant mortality in their home-towns applied to the city of Amsterdam for a long time. While around 22 per cent of children born in the mid-1850s did not survive their first birthday the Annual Report to the Municipal Council of 1853 stated (Gemeentelijk Jaarverslag over het jaar 1853, Amsterdam 1854, p. 57) that "the health situation of young children was in general rather sufficient, exception made for the normal indispositions and the continuous or intermittent suffering of some children from certain diseases". Yet a growing number of medical doctors realised that there was an enormous difference between the health condition and mortality risks of the higher and lower classes of the urban population. They made a case for a health policy that could ensure the health of the whole population and not only of a small segment of its inhabitants (Houwaart, 1991). They argued that this necessitated a systematic analysis of the abuses in public health, an analysis that had to be based on topographical methods and on statistical analysis. This would brought to light the relationship between social and sanitary evils and high mortality. Once this analysis had been completed, health theory could provide the necessary technical solutions to the hygienic problems of society. With that goal in mind medical doctors started to collect statistical data on mortality and to analyse differences in mortality rates. In Amsterdam these studies focused on the differences in mortality between the for official statistical purposes constructed neighbourhoods. The main question here was whether these differences had their origin in differences in prosperity (Bureau van Statistiek der Gemeente Amsterdam, 1936, 1952; Centrale Commissie voor de Statistiek, 1897; Israëls, 1850, 1862). This kind of ecological studies remained in vogue until far in the twentieth century (Van de Mheen, Reijneveld, & Mackenbach, 1996; Van der Maas, Habbema, & Van den Bos, 1987). Medical doctors were above all interested in the inequality in death risks among infants. For a 'better and more confident future for humanity' a 'healthy and powerful youth was a conditio sine qua non' and that made it necessary that 'one was aware of vastness of the dangers that threatened the infant in its earliest youth'(Israëls, 1862, 166). Besides that, in this age group death risks were extremely high and determined for a large part the mortality level of the whole population.

And indeed, between the neighbourhoods of Amsterdam considerable differences in infant mortality were observed. In some poor quarters (XX and ZZ) 35 per cent of the live born children in the period 1854-1859 died before having reached age one whereas in four more well-to-do quarters

infant mortality was only 18-20 per cent. A number of neighbourhoods however fell short of the expectation that the higher the prosperity of the neighbourhood, the lower the infant mortality rate: in the poor neighbourhoods S, R, and P, mainly inhabited by Jews, mortality was clearly lower than could be expected on the basis of the income level of that neighbourhood (F. Van Poppel, 1982).

The finding that neighbourhoods inhabited by Jews had lower mortality than could be expected on the basis of their prosperity is a recurrent finding in studies in the Netherlands (F. Van Poppel, Schellekens, & Liefbroer, 2002) and abroad (R. Derosas, 2003). Studies on Amsterdam in the second half of the nineteenth century explained this phenomenon by a variety of sometimes contradicting factors. Israels referred to the fact that more Jewish mothers breastfed their children and also mentioned the specific location of the neighbourhood (Israëls, 1862), as the Jewish quarters was supposed to suffer less from the effect of stagnant water and had no shortage of fresh air. A comparable argument was put forward by Egeling (Egeling, 1863) who argued that although the Jewish population was ”in majority housed in a very miserable and cramped way” it nonetheless profited from the fact that their part of the town was characterised by a “rather favourable location, so that fresh air could freely run through”. Coronel (Coronel, 1864) mentioned again breastfeeding but stressed that its effect was restricted to the lower social classes only. For Stephan (Stephan, 1904) the explanation lay in the better care that mothers provided and in the low prevalence of syphilis and alcoholism. For Pinkhof (Pinkhof, 1907, 1908), it were not so much the physical characteristics of the neighbourhood that played a role but the life style of the Jews. Some authors have argued that at least part of the religious differences might be considered the result of a statistical artefact. Snel and van Straten suggested that many analyses of the Jewish advantage in infant mortality are biased by a severe underestimation of neonatal mortality among Jews as a large share of stillbirths were in fact neonatal deaths but were not included in the calculation of infant mortality rates (R. Derosas, 2004; Snel & Van Straten, 2006). In the opposite direction might have worked the practice among Roman Catholics to register stillbirths as live births that then were immediately recorded as having died. In this case, the infant mortality rates of Catholics would be too high and their stillbirth rates too low (F. Van Poppel, 2003).

Studies of the effect of prosperity on mortality on the basis of ecological data have their advantages but do not directly answer the question whether prosperity or more differences in the socioeconomic position of children lead to higher mortality. Prosperity is a neighbourhood characteristic and there rarely is a one-to-one relationship between prosperity of its inhabitants and neighbourhood prosperity. Neighbourhoods are often rather heterogeneous and ecological studies therefore underestimate the socioeconomic variation in mortality because individuals with diverse characteristics are grouped together in one neighbourhood category (Sloggett & Joshi, 1994). Thus,

the association between neighbourhood characteristics and mortality levels often disappears when the analysis takes into account the characteristics of the individuals living there. An added problem is that not all neighbourhood characteristics have a direct effect on the health of the inhabitants and often a time-lag would be more to the point.

This is not to say that individual level data on socioeconomic position and mortality are sufficient to answer the question whether poverty is related to mortality risks. After all it is possible that an association between neighbourhood characteristics and prosperity of the inhabitants is in fact responsible for any observed relationship between mortality and prosperity. For example, in a mortality regime dominated by variation in the incidence of infectious diseases, it is the elite's location in a spatially-structured disease environment (presence of effective sewerage, treated water) that mattered for mortality variation, not the advantages that directly go with the prosperity of individuals (Smith, 1991). It is by combining information about the situation of the neighbourhood with information on characteristics of the individuals living there that allows one to unravel the effects of socioeconomic position and neighbourhood (Williams, 1992). The same applies to the role that religion plays in the religion-neighbourhood-mortality equation. To find out whether for the specific situation of Amsterdam religion as a factor played a role up and above that of the neighbourhood where the religious groups lived it is necessary to have individual level information about the religion of the population at risk and the deceased.

Individual level data about the relation between the socioeconomic position and mortality have become available for Amsterdam only since the end of the 1930s (Bureau van Statistiek der Gemeente Amsterdam, 1953). For some other Dutch cities individual level data were published at the time for the last quarter of the nineteenth century but these data are not very detailed, and do not lend themselves to more refined analysis (for an overview, see F. Van Poppel, 1983). Recently rather detailed micro-level data have become available from the random Historical Sample of the Netherlands, but these data are not very well suited for detailed analyses of the effect of place of residence on mortality (Frans Van Poppel, Jonker, & Mandemakers, 2005). The digitalized data from the Amsterdam population register offer however a unique possibility to study for the middle of the nineteenth century the relationship between the socioeconomic position of the child, the religion of the parents, and other familial characteristics, some highly relevant characteristics of the houses and the neighbourhood in which these families lived, and mortality. We focus on the mortality of infants. Studying infants has various advantages. Infant mortality accounts for a very high proportion of the total number of deaths and determines to a large degree the level of the expectation of life at birth and the changes therein. Infant mortality is solely dependent on the prevailing socio-economic and other conditions and not by earlier, potential different, situations of the child and its family. And,

less so than is the case for other age groups, deaths are not overrepresented in certain neighbourhoods due to the presence of institutions such as hospitals.

Our study related to mortality in the first year of life among children born during the year 1851 in Amsterdam. We are able to determine the socioeconomic position of the child on the basis of the occupation of the father, the religion, the age of the mother at the time of birth of the child, the number of other persons present in the household and the composition of that household and the migrant status of the parents. By adding information on stillbirths from the vital registration system we also can shed light on the question whether religious differences were in fact caused by different registration practices that had their basis in religious customs and beliefs.

By combining the precise address location of the residence of each individual in 1851 from the population register with the digitized cadastral map of Amsterdam from the HISGIS Amsterdam project (hisgis.nl/Amsterdam) we are informed about the rental value of the house where children were born. For the streets in which the house was located and for the neighbourhood we can determine various characteristics of the quality of the environment for example by measuring population density, water provision, altitude, social homogeneity etc. We therefore can study

- whether there were socioeconomic mortality differences in infant mortality
- whether neighbourhood conditions reinforced or weakened these mortality differences
- whether or not some religious specific groups were able to escape from this situation by specific health practices and life styles
- whether or not the presence of these groups in a specific neighbourhood also had an effect on those inhabitants that did not share the religion.

Data

Population registers, enforced in the Netherlands by the Royal Decree of December 22, 1849, combine census listings with vital registration in an already linked format for the entire population of a municipality with the household as the registration unit (Alter, 1988, 32-58; Meijer, 1983). For each household member name, date and place of birth, marital status, occupation, religion, and if applicable date of death, date of moving in and date of moving out were recorded. New household members, including live births, were added to the list of individuals already recorded, and those moving out by death or migration were cancelled with reference to place and date of migration or date of death. The population registers parts 1 comprise the entire population register over the years 1851-1853, with exception of one register, neighbourhood F section 1, that was lost. The population register is ordered by address instead of by person. Persons therefor can appear more

than once in the register. The names of persons who were registered at a certain address and moved were strikethrough and entered again at the new address. Dates of departure and arrival were added at the respective addresses in the register. Though family relationships between household members were not registered, birth dates, marital states and family names can be helpful in deriving relationships. The information in the registers was given orally. Sometimes exact birth dates are missing or not consistent with other dates. First and last names sometimes differ between multiple entrances of the same person or civil registration.

We selected from the register all children born in the year 1851 and analyse their survival up to their first birthday. We compared the number of births with the birth register of the civil registration to correct for missing or unidentified births and duplicate registries in the population register. We also added stillbirths from the death register of the civil registration including information on the parents from the death certificates. Our total dataset includes 8,233 births of which 7,645 births direct from the population register, 588 additional births from the civil registration, and 523 stillbirths.

For the new-born children we can determine the socioeconomic position on the basis of the occupation of the father, the religion, the age of the mother at the time of birth of the child, the number of other persons living in the house. From the cadastral map and register we can add the rental value and the exact geographical location of the house. For the neighbourhood we can determine the quality of the environment for example by measuring population density, the water provision, access to health facilities etc.

Results

To study the effects of socioeconomic position and neighbourhood on infant mortality in Amsterdam halfway the 19th century we will first describe our data by using explorative (spatial) descriptives. This includes visualization in maps at the level of both neighbourhoods and the very detailed level of individual house(hold) locations.

Around 1850 Amsterdam had approximately 225 thousand inhabitants. Slightly (10 %) more than at the beginning of the 19th century. Only in the last quarter of the 19th century the population of Amsterdam started to increase rapidly. By the end of the 19th century the population more than doubled to 510 thousand inhabitants (see Figure 1). The population register data 1851 combined with the cadastral map of Amsterdam allow us to visualize the population distribution within the city. Particularly the more (at that time) recently developed areas at the border of the city were very densely populated, as well as the harbour area and the area south-east of the city centre known as the Jewish neighbourhood (see Figure 2).

According to the population register data for the year 1851, about 65% of the population of Amsterdam was Protestant, 22% was Roman-Catholic and 11% was Jewish. The Jewish population lived very concentrated (see Figure 3).

Based on application of the Social Power scheme (SOCPO) of Van de Putte and Miles (2005) to the same population register data, only 2% of the population was classified as elite, 20% middle class, 22% skilled labourers, 37% semi-skilled labourers, and 19% unskilled labourers. The lower class population was concentrated in the most densely populated areas mentioned before.

During most of the 19th century infant mortality rates in Amsterdam were high: around 200 per thousand live births for girls and around 235 per thousand for boys. From 1885 infant mortality rates started to decline (see Figure 4). The percentage of stillbirths was again higher for boys than girls: around 6% for boys and 5% for girls, but started decreasing from halfway the 19th century (see Figure 5). Using the data from the population register 1851, the spatial differences in infant mortality rates can be visualized by neighbourhood (see Figure 6). Infant mortality rates were particularly high in the densely populated poorer areas in the west, east and the south of the city. Infant mortality rates however were low in the thinly populated richer parts of the city and in the (poor) Jewish neighbourhood.

For our explorative analyses of infant mortality patterns in 1851 we used at both the individual, household and neighbourhood level variables available in this stage of our research: religious denomination, socio-economic position (SOCPO), age of the mother at birth, sex of the child, household population density (number of persons per 10 m^2), tax value of the property, additionally, we include 2 measures to capture the availability of medical care by using the distance to the nearest medical doctor, and the distance to the nearest midwife.

Religion

The infant mortality rate in Amsterdam in 1851 was 207 infant deaths per 1000 live births. For the main denominations the infant mortality rates were 216 per 1000 for Protestants, 222 per 1000 for Roman-Catholics and 133 per 1000 for the Jewish population, which is in line with differences reported in previous studies on infant mortality in the 19th century. The population register however provides more detailed information on religious denomination (16 denominations in total, most of them dissented Protestant denominations). Figure 7 shows the nine largest denominations. Almost half of the number of births (49%) are Dutch Reformed, 21% Roman-Catholics, 11% Dutch-Jewish, 10% Evangelical Lutherans, 3% Restored Evangelical Lutherans, 1% Mennonites, 1% Portuguese-Jewish, and 1% Walloon Reformed. Within the Jewish population the

infant mortality rate among Portuguese-Jewish is even lower. Within the Protestant population infant mortality rates are higher for the more orthodox denominations, like the Restored Evangelical Lutherans (271 per 1000) and Mennonites (242), and lower for the more liberal denominations like the Walloon Reformed (170) and the Remonstrants (143). However, due to presumed different registration practices of stillbirths by Catholics and Jews, infant mortality rates and stillbirth rates might be either too high or too low for these denominations. The stillbirth rate for Amsterdam in 1851 is 5.3 stillbirths per 100 births. The stillbirth rate indeed is the lowest for Catholics (4.8 per 100), however only slightly lower than for the Dutch Reformed. The stillbirth rate is the highest for the Dutch-Jewish (6.5 per 100), but only slightly higher for the Portuguese-Jewish (5.7). The stillbirth rate differences do not change the general picture. The recalculated infant mortality rates including stillbirths presented in Figure 8 show more or less the same pattern as Figure 7.

Social class

Infant mortality rate differences are much smaller between social classes than between religions (see Figure 9). Infant mortality rates for the elite and middle class are below average with around 180 infant deaths per 1000 live births. For the lower social classes the infant mortality rates increase with social class. Skilled labourers have the highest rate (227 per 1000), followed by the semi-skilled (213), and the lower skilled (204). However, social class and religious denomination are related. Particularly among the Walloon Reformed and Remonstrants the elite and middle class are overrepresented. The Dutch-Jews and Portuguese-Jews show a mixed pattern: among them both the unskilled labourers and middle class are overrepresented. However, this should be interpreted with care since the in this group common occupation merchant is classified according to the SOCPO scheme as a middle class occupation, whereas in practice a lot of poor street-traders called themselves merchants as well. Compared to Dutch-Jews, among Portuguese-Jews also the elite is overrepresented. Looking at both social class and religion together, the effect of social class tends to decrease. However, even when controlling for social class, the infant mortality rates for Dutch-Jews and Portuguese-Jews remain significantly lower.

Age of the mother and sex of the child

Infant mortality rates are lowest for those with mothers aged 30-34 years (172 per 1000). Infant mortality rates are the highest among those with mothers aged 40+ (age 40-44: 219 per 1000; age 45+: 239 per 1000).

Infant mortality rates are higher for boys (224 per 1000) than girls (190 per 1000). Also stillbirth rates are higher for boys (6.2 per 100 births) than girls (4.9 per 100).

Other characteristics

Whether children are born in densely populated households (number of persons/dwelling area) or not does not affect infant mortality rates. Infant mortality rates are positively correlated with household size (number of persons) though. Infant mortality rates are slightly lower among children born in dwellings with higher (rental) tax values (188 per 1000).

Proximity to healthcare is analysed using the distance to the nearest medical doctor or midwife. Infant mortality rates are higher for those born more than 1 km away from the nearest medical doctor (264 per 1000) and those born more than 1 km away from the nearest midwife (234 per 1000).

Model estimations

All variables discussed in the sections above have been included in a single logistic regression model for individual risk of infant mortality. The results of this analysis are presented in Table 1. The results from the table in general confirm the univariate results presented above. However not all categories remained significant. The most strong effects remain the religious denomination, age of the mother at birth, and the sex of the child. Particularly, the Jewish still stand out. By including all other variables, the Roman-Catholics appear to be worse off than one would conclude from the univariate analysis. Also the effects of the age of the mother and sex of the child remain significant. Though the odds ratios for social classes are in line with the univariate analysis, none of the effects remain significant. The same applies to the other variables.

Rerunning the logistic regression model for risk of infant mortality including stillbirths produces similar estimations. The effect of the sex of the child increases. Also the effect of the size of the household becomes positive and significant.

Future research

The next step will be to extend our analysis by incorporating other health and environment related neighbourhood characteristics. Possible additional variables could be measures for social and religious homogamy, quality of the housing, population density, housing density, indicators for measurement of common open space (width of the streets), social vulnerability, availability of water pumps, toilets, elevation.

Another step is to test for spatial dependence by using spatial statistics like Moran's I and spatial regression modelling. However since we are dealing with both individual (household) and

neighbourhood effects we will need to extend our analysis and models to spatial multilevel modelling (Xu, Logan, & Short, 2014).

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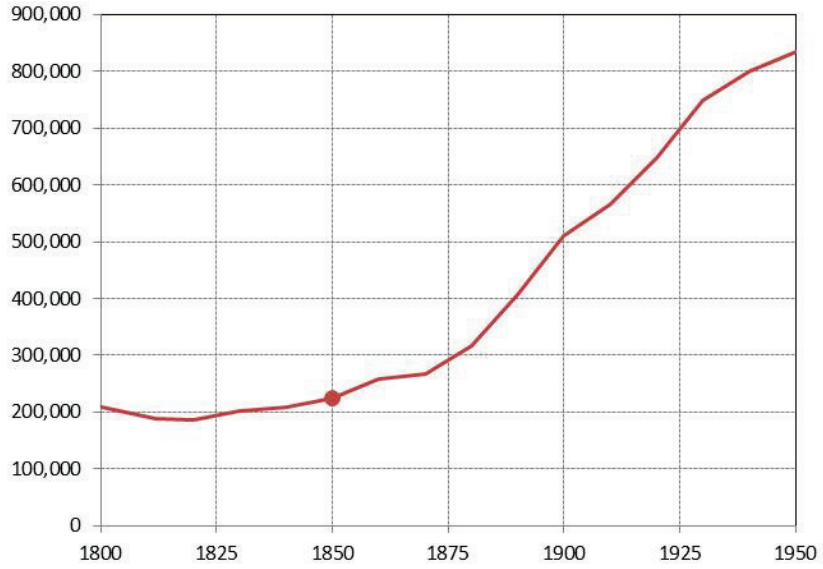
Figure 1. Population size of the municipality of Amsterdam, 1800-1950.

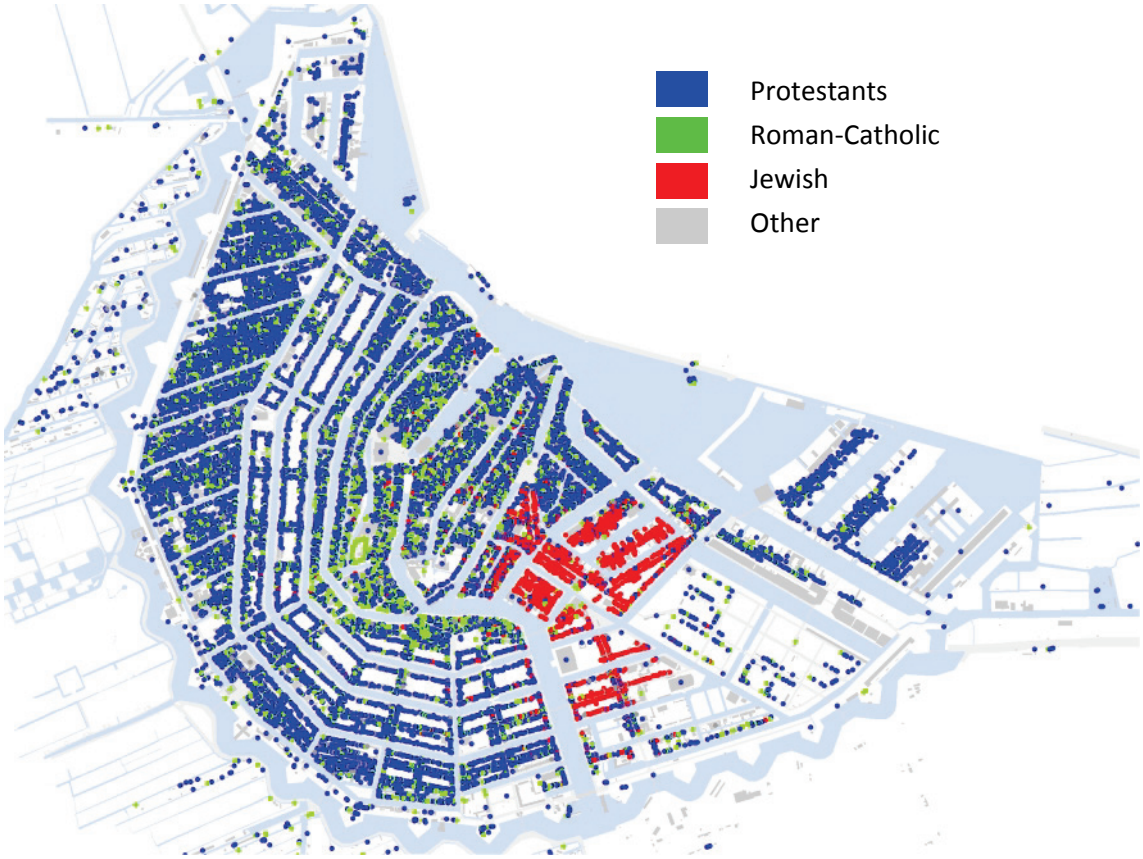


Source: Population censuses.

Figure 2. Population density per building, Amsterdam, Netherlands, 1851

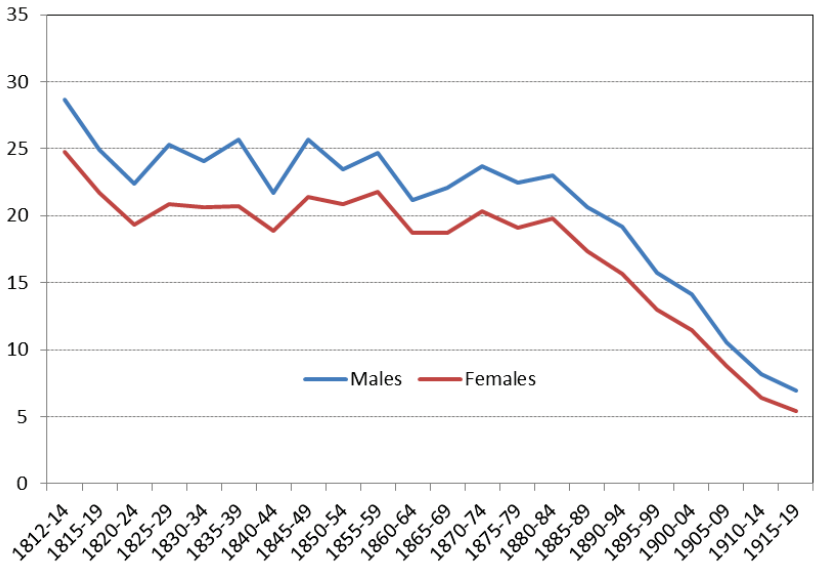
Source: Amsterdam Population Register 1851, HISGIS Amsterdam.

Figure 3. Population by religious denomination, Amsterdam, Netherlands, 1851



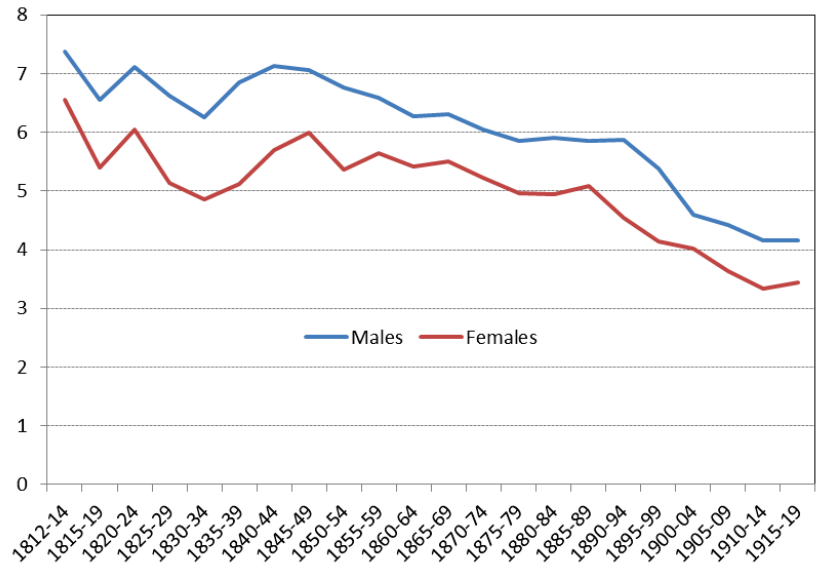
Source: Amsterdam Population Register 1851, HISGIS Amsterdam.

Figure 4. Infant mortality rates, Amsterdam, Netherlands, 1812-1919



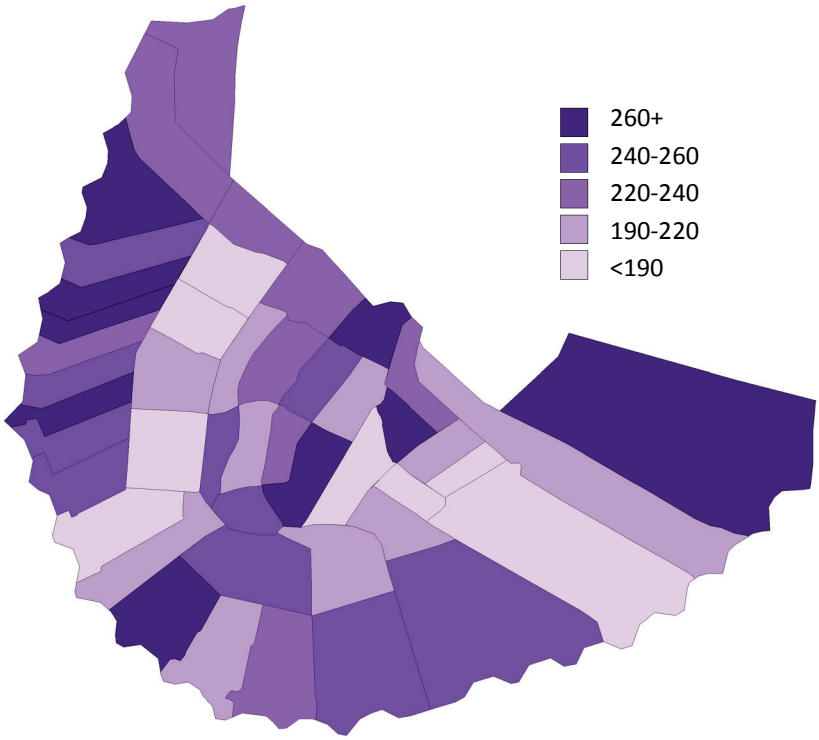
Source: Statistiek der bevolking, 1923, 207-208.

Figure 5. Percentage stillbirths, Amsterdam, Netherlands, 1812-1919



Source: Statistiek der bevolking, 1923, 137-139.

Figure 6. Infant mortality rates by neighbourhood, children born in 1851, Amsterdam, Netherlands



Source: Amsterdam Population Register 1851, HISGIS Amsterdam.

Figure 7. Infant mortality rates by religious denomination, children born in 1851, Amsterdam

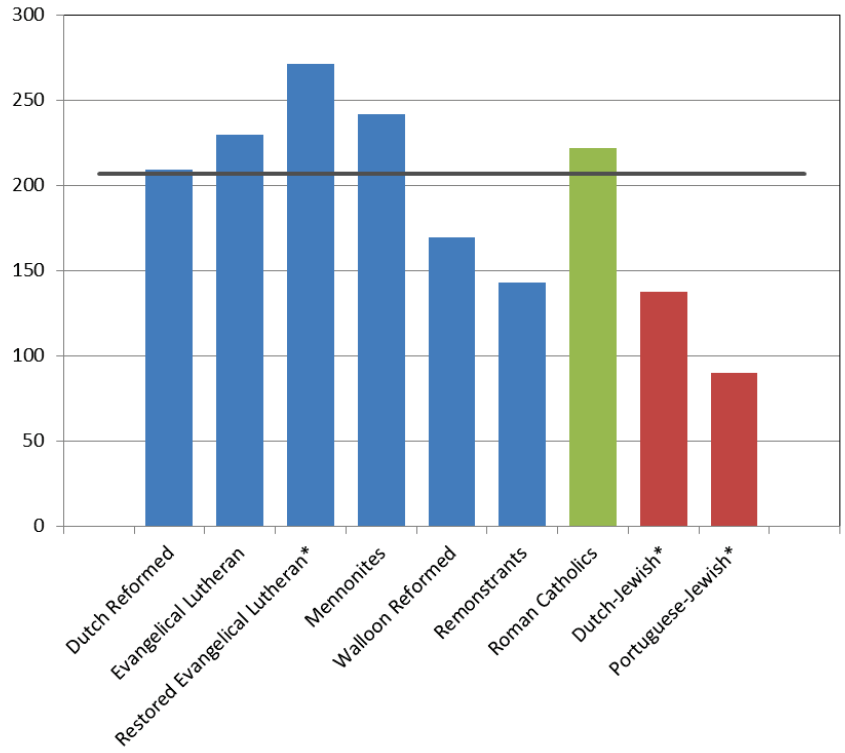
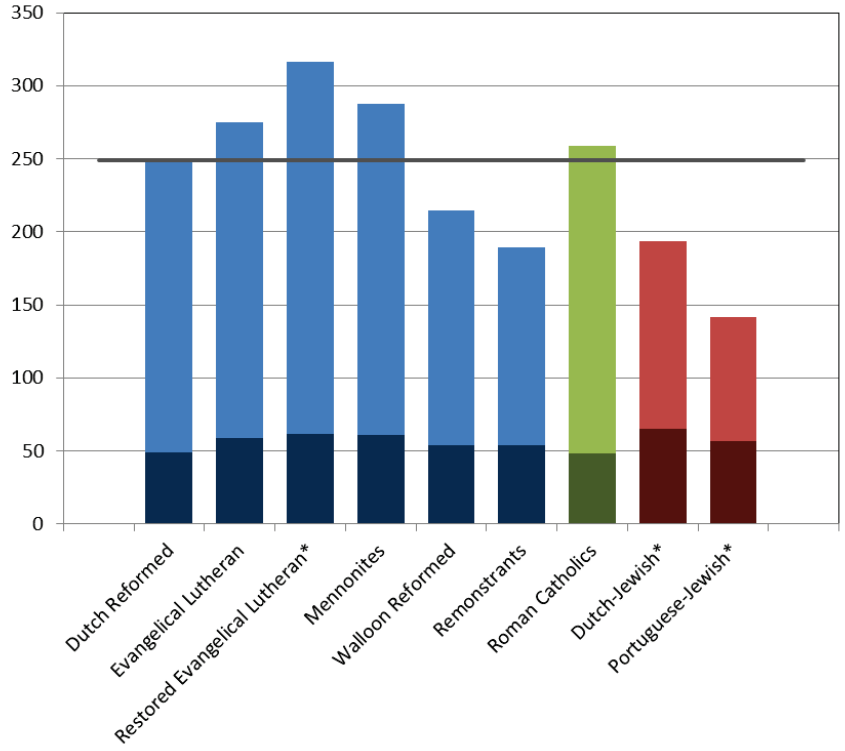
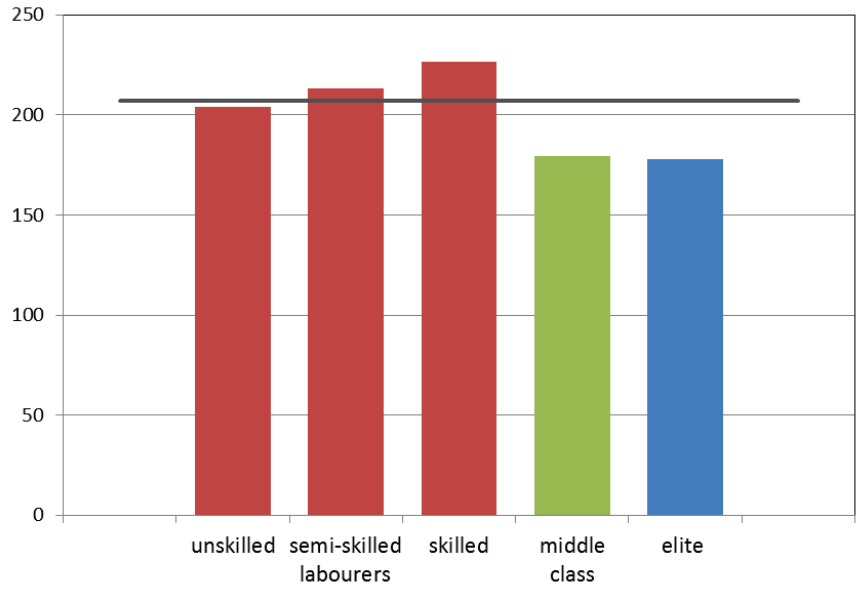


Figure 7. Infant mortality rates including stillbirths by religious denomination, children born (alive and dead) in 1851, Amsterdam



Source: Amsterdam Population Register 1851.

Figure 9. Infant mortality rates by social class (SOCPO), children born in 1851, Amsterdam



Source: Amsterdam Population Register 1851.

Table 1. Logistic regression for infant mortality, children born 1851, Amsterdam, Netherlands

Variable	Odds ratio	P	[95% Conf.	Interval]
Sex of the child				
Female	(reference)			
Male	1.2275	***	1.0737	1.4032
Mother's age at birth				
<20	1.0085		0.3790	2.6833
20-24	1.1866		0.9101	1.5471
25-29	1.1350		0.9451	1.3631
30-34	(reference)			
35-39	1.1556		0.9564	1.3965
40-44	1.3584	***	1.0820	1.7055
45+	1.6054	*	1.0084	2.5556
Religion				
Dutch Reformed	(reference)			
Evangelical Lutheran	1.0807		0.8689	1.3440
Restored Evangelical Lutheran	1.2928		0.8876	1.8829
Mennonites	1.5198	*	0.9246	2.4980
Walloon Reformed	0.9015		0.3723	2.1830
Remonstrants	0.7595		0.2216	2.6036
Roman Catholics	1.2467	***	1.0563	1.4713
Dutch-Jewish	0.5837	***	0.4455	0.7649
Portuguese-Jewish	0.2794	**	0.1008	0.7747
Social class (SOCPO)				
Unskilled workers	(reference)			
Semi-skilled workers	0.9265		0.7410	1.1583
Skilled workers	1.0404		0.8632	1.2540
Middle class	0.9359		0.7553	1.1598
Elite	0.7622		0.4724	1.2299
Household density (persons /10 m^2)	0.9966		0.9683	1.0257
Household size (number of persons)	0.9869		0.9547	1.0202
Tax value				
<100	(reference)			
100-200	0.9338		0.7889	1.1053
200-300	0.8780		0.6992	1.1024
300-500	0.8735		0.6842	1.1153
500+	0.7889		0.5307	1.1726
no tax	0.6904		0.3755	1.2694
Distance to nearest medical doctor				
<200 m	(reference)			
200-400 m	1.0695		0.9136	1.2521
400-600 m	0.9290		0.7474	1.1549
600-1000 m	1.1761		0.8189	1.6892
1000 m +	1.0804		0.6160	1.8951

Distance to nearest midwife			
<200 m	(reference)		
200-400 m	1.0574	0.8958	1.2481
400-600 m	0.8930	0.6819	1.1695
600-800 m	0.8907	0.6383	1.2429
800-1000m	1.2532	0.8439	1.8610
1000 m +	1.0676	0.7597	1.5004

Significance: * p<0.10, ** p<0.05, *** p<0.01

Table 2. Logistic regression for infant mortality including stillbirths, children born (alive and dead) in 1851, Amsterdam, Netherlands

Variable	Odds ratio	P	[95% Conf. Interval]	
Sex of the child				
Female	(reference)			
Male	1.2701	***	1.1202	1.4401
Mother's age at birth				
<20	1.1483		0.4889	2.6974
20-24	1.0716		0.8330	1.3784
25-29	1.0448		0.8801	1.2401
30-34	(reference)			
35-39	1.0969		0.9195	1.3084
40-44	1.3448	***	1.0894	1.6602
45+	1.4578	*	0.9351	2.2729
Religion				
Dutch Reformed	(reference)			
Evangelical Lutheran	1.0920		0.8896	1.3404
Restored Evangelical Lutheran	1.2645		0.8834	1.8099
Mennonites	1.5093	*	0.9393	2.4253
Walloon Reformed	0.7851		0.3245	1.8997
Remonstrants	0.8770		0.2936	2.6200
Roman Catholics	1.1952	**	1.0204	1.3998
Dutch-Jewish	0.7342	***	0.5808	0.9281
Portuguese-Jewish	0.3540	**	0.1517	0.8261
Social class (SOCPO)				
Unskilled workers	(reference)			
Semi-skilled workers	0.9499		0.7695	1.1726
Skilled workers	1.0685		0.8950	1.2757
Middle class	0.9971		0.8160	1.2184
Elite	0.7400		0.4669	1.1728
Household density (persons /10 m^2)	0.9929		0.9665	1.0200
Household size (number of persons)	1.0486	***	1.0202	1.0777
Tax value				
<100	(reference)			
100-200	0.9642		0.8225	1.1304
200-300	0.8927		0.7206	1.1058
300-500	0.8995		0.7155	1.1307
500+	0.7490		0.5129	1.0937
no tax	0.6914		0.3898	1.2263

Distance to nearest medical doctor			
<200 m	(reference)		
200-400 m	1.1280	0.9739	1.3064
400-600 m	0.9621	0.7853	1.1787
600-1000 m	1.1039	0.7771	1.5680
1000 m +	1.1976	0.7129	2.0118
Distance to nearest midwife			
<200 m	(reference)		
200-400 m	1.0690	0.9158	1.2477
400-600 m	0.8665	0.6703	1.1201
600-800 m	0.8993	0.6582	1.2288
800-1000m	1.2590	0.8673	1.8275
1000 m +	0.9994	0.7192	1.3887

Significance: * p<0.10, ** p<0.05, *** p<0.01