Long Abstract A competing risks analysis of victims and survivors: The impact of different socioeconomic factors on cause-specific early child mortality risks in Amsterdam, 1856-1865

Mayra Murkens, Tim Riswick, Jeanine Houwing-Duistermaat (Radboud University)

Introduction

Pre-epidemiologic transitional societies were characterized by extremely high levels of infant- and early childhood mortality. The young in particular where the ones who succumbed to a variety of infectious diseases, when prolonged immunity from the mother waned towards the end of infancy. Scarlet fever, measles, whooping cough and diphtheria caused most victims, although not all children were exposed to similar risks of dying from these diseases. Differences between socioeconomic groups could be an important reason for health inequalities among young children in the nineteenth century, although this relationship is still highly debated (Reid 1997, Oris, Derosas and Breschi 2004, Dribe and Karlsson 2021).

Although it has been argued that the decline in infant mortality (0-1 year) and early childhood mortality (1-4 year)are often correlated (Wolleswinkel-van den Bosch 1998, Woods 2000, Jaadla and Reid 2017), several arguments can be made for studying early childhood mortality separately from infant mortality. While infant mortality started to decline in many western-European countries between the 1870s and 1900 (Woods, Watterson and Woodward 1988), the secular mortality decline among young children started earlier. Some regions experienced a decline in early childhood mortality as early as the 1850s, while other regions joined this trend up until the 1870s (Perrenoud 1997, Wolleswinkel-van den Bosch 1998, Davenport 2020). As the timing of mortality decline for infants and young children is different, also the factors influencing the decline may differ substantially. One of these factors is socioeconomic status, for which the literature finds distinct patterns. The literature views infancy, in particular the first months of life, as the period where biology is the main determinant of mortality inequalities. This changes into early childhood, when socioeconomic factors become more important in determining mortality differentials (Oris, Derosas and Breschi 2004, van Poppel, Jonker and Mandemakers 2005).

The mechanisms of socioeconomic inequalities in mortality remain highly debated as well. According to one school of thought, a persistent socioeconomic gradient in mortality existed throughout history (Link and Phelan 1995, Marmot 2004). Clouston et al. expanded this train of thought, better known as the constancy-hypothesis, by incorporating specific disease mechanisms. In that sense, a socioeconomic gradient was not static for specific diseases, as it could emerge or vanish, yet on the whole new diseases would continue to arise through which a gradient could be expressed, creating a continuous socioeconomic gradient in health through time (Clouston, Rubin et al. 2016, Clouston and Link 2021). The crucial element of the disease mechanisms is the availability of and access to a set of flexible resources, their nature being dependent on the specific disease. According to this model, the higher social classes gain access to these resources, once they become available, prior to the lower social classes, which explains their temporary health advantage.

Not all studies, however, find these socioeconomic disparities in all historical settings. Hence the other school of thought follows what Antonovsky coined the divergence-convergence hypothesis (Antonovsky 1967). In the early modern period, health circumstances were more or less similar for all social strata, which created equal health risks. Due to economic advances and a transition towards a predominance of nutrition related diseases, social inequalities started to arise towards the end of the early modern period and at the brink of the modern era. Once modernization progressed, the increased inequalities diminished again, and a period of converging health risks due to class started

(Antonovsky 1967). Many studies have abided the divergence-convergence hypothesis, although recently studies- mainly using Scandinavian data- have started to question whether a socioeconomic gradient ever existed prior to the twentieth century (Bengtsson and Dribe 2011, Bengtsson and van Poppel 2011, Bengtsson, Dribe and Helgertz 2020)

Our study

The field is currently hampered by two challenges. The first is that although socioeconomic disparities may be absent in certain historical contexts, in some other cases existing inequalities may be merely concealed. Studies that have to rely on only all-cause mortality often overlook these inequalities, as differences in cause-specific mortality rates may level each other out. The use of individual-level cause-of-death data can help to overcome this issue, as these data allow for a more detailed analysis of the relation between cause specific mortality and individual characteristics, such as socioeconomic status. The second challenge is the chosen operationalisation of socioeconomic status. This may affect research outcomes, as we are not yet certain how proxies such as occupation, wealth and education play out differently. The effects of socioeconomic status also did not operate in a vacuum, contrarily, socioeconomic status is often closely entangled with and affected by spatial characteristics. Moreover, in most historical studies, only information on occupation, of mostly adult men, is available.

This study aims to shed more light on these methodological complexities by investigating socioeconomic disparities in child mortality in mid-nineteenth century Amsterdam (1856-1865).This is key to be able to understand if inequalities in health existed for young children, and in what ways these differ from infant mortality, before the start of the health transition. Our goals are twofold. First, we examine how socioeconomic differences potentially caused disparities in cause-specific early childhood mortality. Since there was a variety of potential causes of death, the mortality rates of different types of diseases may affect each other. For example, when an epidemic hits and many die, a smaller population is available for other diseases. By adopting a competing risks research design, we account for those interactions between diseases and disease categories. With this competing risks approach, using Cox proportional hazards models, we can calculate whether lower classes experienced higher cause-specific mortality hazard ratios compared to the higher classes.

In order to do so, we use truly unique historical individual-level life course data of all children born (n= 31,132) in Amsterdam during the period 1856-1860, who survived at least until age one. The ones who die before age five are linked to information from the Amsterdam Cause-of-death Database (ACD), providing the specific cause of death. These causes of death were all coded according to the SHiP+ coding scheme (Janssens 2021), on which we based our own classification scheme including five meaningful categories of death: water- and foodborne infectious diseases, airborne infectious diseases, other infectious diseases, non-infectious causes of death, and finally unknown causes of death. Next to studying specific causes of death, we apply a research design that allows for the use of three different indicators of socioeconomic status to further our understanding of the complex relationship between the household, housing and neighbourhood level. Respectively occupational data, housing rent data, and a contemporary neighbourhood wealth classification are examined to study if the type of proxy used for socioeconomic status matters as well.

Preliminary results

In the Netherlands, early childhood mortality started to decline from 1859 onwards (Wolleswinkel-van den Bosch 1998). Amsterdam was, to our knowledge, no exception to that general trend, as early childhood mortality was slightly declining from the moment cause-of-death data is available onwards, in 1856 (Figure 1). Infant mortality continued to be at a relatively high level for the decades to come. Despite differences in the onset of mortality decline, both infants and young children

continued to be plagued by epidemic outbursts, as can be seen in the mortality spikes in Figure 1. Early childhood mortality was also already substantially lower compared to infant mortality. Still, the mean early childhood mortality in the late 1850s and early 1860s was 60-50 per thousand children.

In the period under study, the risks of dying were clearly affected by socioeconomic status. Figure 2 demonstrates the hazard ratios of all-cause mortality, as a result of the Cox survival analysis, compared to the reference group, which was the group with the lowest socioeconomic status. A social gradient appeared for all three socioeconomic status variables, implying that children from the elite and lower middle classes, children living in houses with the highest 50 per cent of rental values, and children living in wealthier neighbourhoods than the poor, all experienced lower risks of dying. Gender did not cause clear mortality differentials, which is not too surprising in this age category, where a clear gender difference is not found uniformly in the literature as well (Tabutin and Willems 1998, van Poppel 1999).

When investigating specific disease categories, our results show that socioeconomic inequalities existed for all disease categories among young children. The most meaningful and statistically significant results, however, are found firstly among the largest disease category, the airborne infectious diseases (Figure 3), and secondly, among the unknown causes of death (not shown here). The majority of the children dying in mid-nineteenth century Amsterdam, died of an airborne infectious disease. A clear social gradient existed for this disease category, as the higher classes experienced lower mortality hazards. All three indicators of socioeconomic status reflected these inequalities, with not one factor being substantially more important than the other. Once delving deeper into specific airborne diseases (Figure 4), only a couple of socially differentiated diseases, being mainly tuberculosis, diphtheria and measles, contributed to the overall mortality gradient among airborne diseases. Among the unknown causes of death an even stronger social gradient existed, implying that medical consumption of the lower classes was lower compared to the higher classes. These children were probably not attended by a medical doctor before their death, which left the doctor oblivious when required to assign what had caused the death of the child.

Preliminary conclusion

Our study has shown clear differential early childhood mortality by socioeconomic status, at all three levels of measure, the household, the housing and at the neighbourhood level. It has been argued that historical socioeconomic disparities become more pronounced after the first year of life. As such, studies have found both existing, temporarily existing, or no socioeconomic inequality in historical infant mortality at all. Conversely, a recent study on Amsterdam infant mortality for the year 1856 showed that also among infants such disparities existed (Muurling & Ekamper forthcoming). However, these disparities did occur in different disease categories compared to the differences between the socioeconomic strata that we observed. Among infants, the first months of life were most discriminatory, which was most likely rooted in the differences in the health of the mother, as mainly congenital diseases and birth disorders disadvantaged the poorest infants. Also the mortality due to unknown causes of death caused inequalities among infants. In our study, we observed inequalities in all disease categories, albeit not all socioeconomic status variables caused statistically significant effects across all these disease categories. Since the vast majority of deaths among young children were caused by airborne infectious diseases, the inequalities caused by this category weighed the most. The case of Amsterdam adds thus an important nuance to the debate whether socioeconomic inequalities in mortality were mainly present in early childhood opposed to infancy. Indeed, even when socioeconomic inequalities existed in both infancy and early childhood, these socioeconomic inequalities did not necessarily have the same origin.

Figures

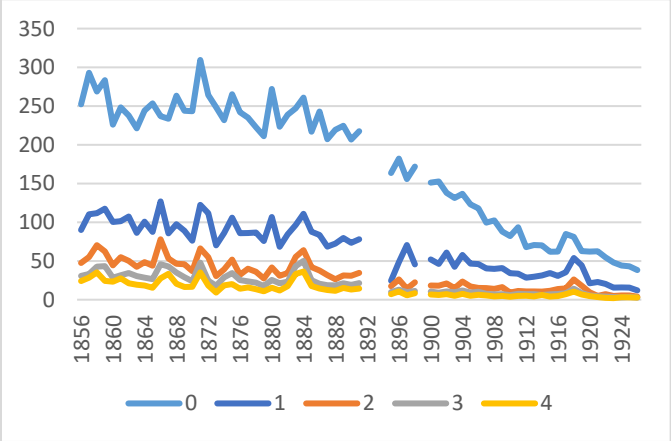

Figure 1: Early childhood mortality by age in Amsterdam, 1856-1926

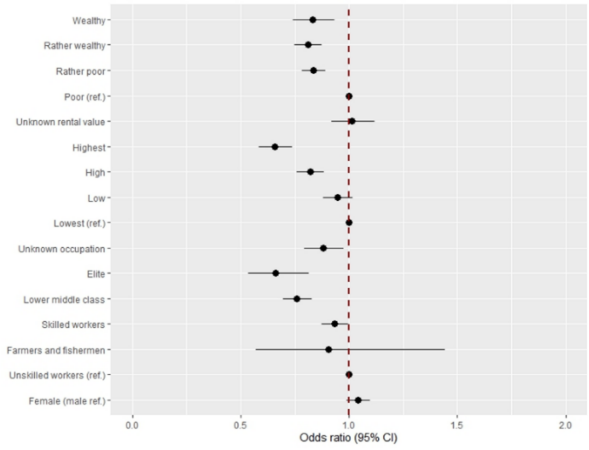

Figure 2: All-cause early childhood mortality hazard ratios by three indicators of socioeconomic status and gender, Amsterdam, 1856-1865

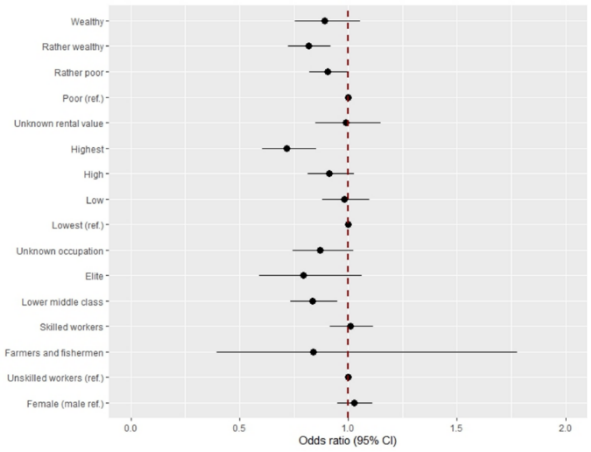

Figure 3: Airborne infectious diseases early childhood mortality hazard ratios by three indicators of socioeconomic status and gender, Amsterdam, 1856-1865

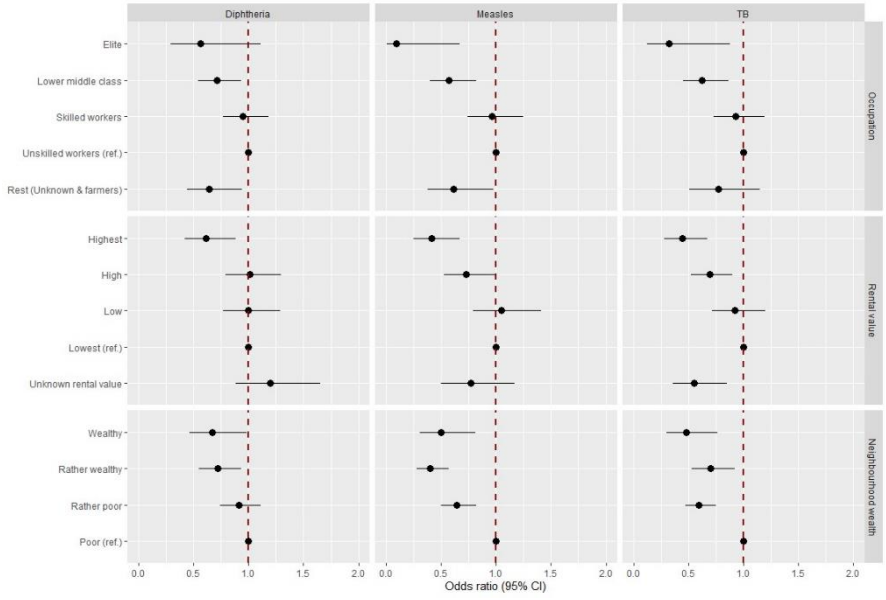

Figure 4: Diphtheria, measles and tuberculosis early childhood mortality hazard ratios by three indicators of socioeconomic status, Amsterdam, 1856-1865 (separate models)