Disfavored in Life, Favored in Death? Later-Life Mortality Differences (Ages 30+) between Migrants and Natives in Antwerp, Rotterdam and Stockholm, 1850-1930

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Abstract: *»Benachteiligt im Leben, begünstigt im Tod? Unterschiede in der Erwachsenensterblichkeit (Altersgruppe 30+) zwischen Migranten und Einheimischen in Antwerpen, Rotterdam und Stockholm, 1850-1930«.* Differences in adult mortality were studied between natives and domestic and international migrants in three Northwestern European cities during different stages of the epidemiological transition. Event history analysis was conducted for mortality risk at ages 30+ using life course data retrieved from three large historical demographic micro-level databases. Results provide ample evidence of healthy migrant effects in Antwerp, Rotterdam, and Stockholm, and the effect was particularly strong among domestic migrants in Rotterdam. The multivariate analyses show that the early life environment, as well as positive selection effects, contributed to the healthy migrant effect: As migration distance increased, mortality risks declined. Being born in the countryside and moving later in life to a city were also associated with lower mortality risks. Although migrants overall had lower mortality risks than natives, we discovered, four vulnerable sub-groups whose mortality risk not only increased, but eventually exceeded that of natives: (1) rural migrants in the period when major epidemics belonged to the past, (2) international migrants who lost their partner, (3) Italian and Italian-speaking Swiss men in Rotterdam, and (4) medium-distance domestic migrant men in Antwerp.

Keywords: Migration, later-life mortality, healthy migrant effect, urban penalty, early life environment, social exclusion.

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1. Introduction

Demographic and epidemiological research has found ample evidence of a so-called 'healthy migrant effect' in contemporary Western populations, referring to a situation in which migrants have a better health status, higher life expectancy and significantly lower mortality risks compared to the native population. The phenomenon was discovered during the 1980s in the United States and was initially referred to as an 'epidemiological paradox', as the results were rather counterintuitive. It turned out that Hispanic migrants in the U.S. have lower mortality risks than U.S. born residents, although they originate from countries with lower living standards and higher mortality rates. At the same time, their socioeconomic position and level of instruction are lower than that of U.S. born residents, and their access to health services is limited (Markides and Coreil 1986). Later research confirmed that first generation Latin American immigrants in the United States have lower overall mortality risks compared to the non-Hispanic White American population (Markides and Eschbach 2005; Lariscy, Hummer and Hayward 2015). Comparable results were also found for Mediterranean migrants in Europe (Khlat and Courbage 1996; Razum, Zeeb, Akgün and Yilmaz 1998).

While for contemporary Western populations mortality differences between migrants and natives have been studied extensively, for historical populations this topic has only occasionally been addressed (see e.g. Alter and Oris 2005, Kesztenbaum and Rosenthal 2010). We set out to study mortality differences between migrants and natives in European cities in the late nineteenth and early twentieth centuries. We highlight three main reasons why this is an interesting comparison. Firstly, evidence of a healthy migrant effect in the past suggests that the effect is more universal: existing in different societies, among various groups of migrants, and under different mortality regimes with dissimilar death rates and distinct causes of death. Secondly, studying mortality differences between migrants and natives can lead to a better understanding of the relationship between early life environment and later life mortality, as migrants grew up in a different environment than native urban residents. The third advantage of studying differences in adult mortality among migrants and natives is the fact that mortality differences can provide greater insight into social health inequalities, and therefore can help identify social exclusion among migrants. After all, if excess mortality among natives is to be expected, an opposite pattern suggests that (certain groups of) migrants faced severe discrimination in the receiving society. Such discrimination could have led to a situation in which migrants had less access to basic facilities like clean drinking water, sanitation, nutrition, and health care services (including vaccination programs), or that they had to take on risky and badly paid jobs (Lee 1999). Social exclusion is also believed to have contributed to migrants being more prone to risky behaviors, including heavy drinking, unsafe sexual activity, and crime (Moch 2003).

In this article, we study differences in adult mortality (ages 30+) between natives and internal and international migrants in three different Northwestern European cities in the period 1850-1930 with the help of event history techniques. This comparison is innovative as most studies have either compared mortality differences of natives and international migrants, or they have compared internal migrants with natives, while few studies compare all three social groups in one complete analysis (Wingate and Alexander 2006). We have chosen Antwerp, Rotterdam, and Stockholm because all three cities experienced very similar developments in terms of total population development, migration, and overall mortality decline, while at the same time the opportunity structure for migrants varied substantially between these cities, suggesting that major differences in social inclusion and exclusion existed between the cities. The life course data are retrieved from three large historical micro-level databases: The Antwerp COR*-Database (Matthijs and Moreels 2010), the Historical Sample of the Netherlands (Kok, Mandemakers and Bras 2009), and the Stockholm Historical Database (Geschwind and Fogelvik 2000).

The latter half of the nineteenth and early twentieth century is an ideal time frame to study differences in adult mortality between migrants and natives, as this period covers all three phases of the epidemiological transition: (1) the 'age of pestilence', (2) the 'age of receding pandemics', and (3) 'the age of degenerative and man-made diseases' (Omran 1971). This enables us to investigate whether or not healthy migrant effects existed during all three phases of the epidemiological transition. It is also an interesting period to compare mortality risks between migrants and natives, as urban in-migration accelerated during this period, and concerns about the incorporation of migrants into mainstream urban society rose (Lucassen and Lucassen 2011; Moch 2003). Several studies show that migrants in the nineteenth and early twentieth century were indeed disfavored in life (e.g. Puschmann et al. 2015), but were they favored in death? And if so, was this the case for all migrants? Migration is known to be a very selective process, as moving requires a certain degree of human capital, including financial means and information about the destination (Lucassen 2004). Good health is another requirement to move. Given the fact that certain moves – for example, over long distances – require more human capital and more physical strength than others, we expect substantial differences in mortality outcomes within the heterogeneous migrant population. An important aim of the paper is to explore this variation in mortality risks by making use of interaction terms.

2. Theory and Empirical Evidence

2.1 Healthy Migrant Effects and Salmon Bias

Many studies on Western populations report that in-migrants have a better health status, lower mortality risks and higher life expectancy than the native population. Even infants born to immigrant women enjoy health advantages compared to infants from native women (Wingate and Alexander 2006). The healthy migrant theory departs from the idea of a positive selection effect. It is argued that people who are healthy are more able and more likely to move than the sick, unhealthy, and disabled and that the healthiest persons move over the longest distances. The process of moving over long distances requires physical capability, while adapting to both a foreign language and a different culture and lifestyle demand good mental health, as these processes are known to cause stress (Fu and VanLandingham 2012). At the same time, labor migrants often take up physically demanding jobs. Less healthy persons might be less suited and less willing to take up such challenges (Lu and Qin 2014). With regard to nineteenth-century Eastern Belgium, Alter, Oris, and Broström (2001) found evidence of such a selection mechanism. For the village of Sart, they observed that individuals from families which experienced death among their members were less likely to leave the village than individuals from families without such bereavements.

Several studies have argued that differences in health and mortality between migrants and natives result (at least partially) from differences in lifestyle (Abraído-Lanza, Dohrenwend, Ng-Mak and Blake Turner 1999; Khlat and Darmon 2003; Lariscy, Hummer and Hayward 2015). Evidence has been found that migrants live healthier lives and exhibit more health-protective behaviors. First generation migrants from Latin American countries in the U.S. are, for instance, less likely to smoke and drink alcohol than U.S. born residents. However, the more migrants adapt to U.S. society, the higher the risk that they start to consume cigarettes and alcohol (Abraido-Lanza, Chao and Flórez 2005). This might explain why, in certain studies, it has been observed that the healthy migrant effect diminishes or disappears as migrants reside longer in the host society (Abraído-Lanza, Armbrister, Flórez and Aguirre 2006). However, in the case of nineteenth-century cities, the waning health advantage might have been, rather, a result of the dramatic urban living environment. Kesztenbaum and Rosenthal (2010) found that the health advantage that rural-to-urban migrants had upon arrival in late nineteenth-century French cities faded away after having lived for some years in a city. They explain this by referring to the bad sanitation in the urban world at the time. Oris and Alter (2001) found comparable results for Belgian cities in the nineteenth century and came to similar conclusions.

Certain studies have suggested that differences in mortality risks between migrants and natives result from differences in early life conditions (Alter and Oris

2005; Bengtsson and Mineau 2009; Smith et al. 2009). The so-called life course trajectory model proposes that early life circumstances are linked to later life outcomes through accumulated experiences during one's life course (Goldman 2001). From this perspective, nutrition, vaccination, household composition, and household resources during childhood might affect later life morbidity and mortality. For our purposes, the early life model is especially interesting with respect to the environment in which individuals grew up, since urban mortality rates exceeded rural mortality rates during the age of pestilence. High urban mortality was a consequence of high population pressure, poor sanitation, and – during industrialization – pollution. For nineteenth-century Belgium, Alter and Oris (2005) found that rural migrants experienced lower post-reproductive mortality rates, even if their move to the city had taken place more than ten years earlier. They explain this by the fact that these migrants had grown up in a healthier environment and had experienced less disease in childhood. However, at the same time this made these migrants more susceptible to epidemic diseases, since rural migrants had been less exposed to such diseases earlier in the life course, and accordingly, they were less often immune to epidemics. That was the reasoning Alter and Oris (2005) used to explain why the healthy migrant effect was in nineteenth-century Belgium weaker during years of epidemic outbreaks.

Some scholars have presumed that lower mortality risks among migrants are only a statistical artifact, resulting from the under-reporting of deaths among migrant populations, and/or selective out-migration of unhealthy and diseased people. This hypothesis is called 'salmon bias' and refers to a situation in which migrants' death rates are artificially lowered. This happens if migrants return home before they die and, in such a situation, the deaths of migrants do not contribute to the national death statistics of the country of study in which they become 'statistically immortal' (Abraido-Lanza, Dohrenwend, Ng-Mak and Turner 1999). Some studies indeed find evidence of a salmon bias effect, but the effect is usually too small to account for the observed differences in mortality risks between migrants and natives, meaning that at least part of the observed health advantage of migrants is real and not merely a statistical artifact (e.g. Razum, Zeeb and Rohrmann 2000).

2.2 Social Exclusion and Excess Mortality among Migrants

Mortality differences between different ethnic and racial groups in society reveal important social inequalities in life chances and health that go beyond differences in economic performance and are often related to severe discrimination and exclusion (Sen 1998; Nazroo 2003). This is, for example, true for disparities in death rates between blacks and whites in the U.S. Although the majority of these disparities are due to differences in socioeconomic status (which are at least partially a result of discrimination in the labor market), there is an important racial gradient: Even if blacks and whites earn the same amount

of money, blacks still have higher mortality risks than whites (Sorlie et al. 1992). Segregation plays an important role in this respect, since blacks pay a price for ending up in economically deprived neighborhoods (Guest, Almgren and Hussey 1998). In this respect, Sen (1998) came to remarkable conclusions when he compared the survival rates of black men and women from Harlem (an African American neighborhood in New York City with high poverty and crime rates) with those of men and women from developing countries with much higher mortality rates at the country level and lower GDP per capita. It turned out that the black men and women from Harlem have lower survival rates than the men and women from China and Kerala (India), and that black men from Harlem had even higher mortality rates for ages 40+ than Bangladeshi men who were facing starvation.

Differences in mortality can uncover social inequalities regarding sex, social class, race, religion, but also due to migration status. Scholars have indeed pointed out the relevance of mortality figures with respect to studies on social inclusion and exclusion of migrants (e.g. Berman and Phillips 2000; Marmot 2005), but hardly any empirical studies have been carried out in which mortality is used as an indicator of social inclusion or exclusion among migrants. This might be related to the fact that studies on social inclusion usually start from identifying a certain kind of disadvantage or deficiency among a migrant population in comparison to the native population, for example, in terms of educational attainment, language proficiency, average income, level of employment, membership of associations, share of voters, etc. After the deficiency is identified, it is studied whether this disadvantage attenuates over the life course and over generations. If this is the case, it can be concluded that social inclusion was successful, as major disadvantages among migrants have faded away and migrants have started to behave and/or perform as well as (or even better than) the natives.

If we take mortality as an indicator of social inclusion and exclusion of migrants, we need to take another approach, since studies on the healthy migrant effect show that, with respect to mortality, migrants already have an advantage compared to the native population. Moreover, adaptation might even worsen the health situation of the migrants (Abraido-Lanza, Chao and Flórez 2005). Accordingly, a study on social inclusion and exclusion does not depart from a situation in which a migrant group as a whole faces some kind of disadvantage over natives, which fades away as social inclusion improves. Rather, we start with a situation in which excess mortality among natives is the norm. This is interesting because every situation in which a migrant group experiences higher mortality than natives deserves an explanation. In this respect, we follow a similar line of thought as can be found in the, by now, well-established literature concerning excess female mortality (Coale and Banister 1994; Das Gupta 1987). Under equal access to nutrition and healthcare, women have lower mortality risks than men in all age categories (Cohen 2000). Consequently, in situations in which excess female mortality exists, women face severe discrimina-

tion. This can be in the form of limited access to food and health care, but can also be a consequence of neglect, violence or female infanticide. Accordingly, we reason that since migrants under normal circumstances enjoy higher life expectancy and lower mortality risks than natives, excess mortality among migrants is a sign of vast inequality between migrants and natives. Excess mortality among migrants indicates social exclusion in core domains of society, which is of such a severe nature that it turns the health advantage of being a migrant into a health disadvantage.

Evidence has been found that certain categories of migrants who were badly integrated in the nineteenth- and early twentieth-century labor market experienced higher mortality risks than natives, probably because they ended up more often in unhealthy and dangerous jobs (Lee and Marschalck 2002; Oris and Alter 2001). Scholars of the Chicago School of Sociology (e.g. Park 1928), as well as some of their followers (Handlin 1955; Bouman and Bouman 1955; Chevalier 1973; Lis 1986), have stated that migrants, given their marginal position in the receiving society, were prone to risky behavior, like heavy drinking, crime and, in case of women, out of wedlock sexuality, including prostitution (Moch 2003). Migrants were even believed to have faced higher risks of suicide, partially caused by problems of adaptation, social deprivation and the resulting misery from living in the city. Poverty was a challenge to many of the urban newcomers. Due to their marginal position in the labor market, migrants faced hunger and ended up in overcrowded dwellings, lacking basic sanitation. Scholars of the Chicago School of Sociology have always emphasized that the social inclusion processes of migrants were hampered by the fact that migrants lacked a (much needed) social network.

3. Research Objectives and Expectations

The first objective of the paper is to evaluate whether healthy migrant effects existed in Antwerp, Rotterdam, and Stockholm in the period 1850-1930, whether this effect was found for both domestic and international migrants, and whether this was the case during all three phases of the epidemiological transition. If healthy migrant effects are found, the underlying causes will be examined. We will address selection effects, as well as the early life environment. With regard to selection effects, the relationship between migration distance and mortality is being examined. We expect that a negative linear relationship existed between both variables as a result of a positive selection effect: The further the migrants moved, the lower their mortality risks were. The basic underlying idea is that moving over longer distances requires more physical and mental strength than moving over shorter distances. At the same time, moving over larger distances requires financial means and information about the city of destination, which suggests that long-distance migrants are also positively selected in terms

of educational profile and socio-economic status. Likewise, they might have moved more often within a network (Sewell 1985).

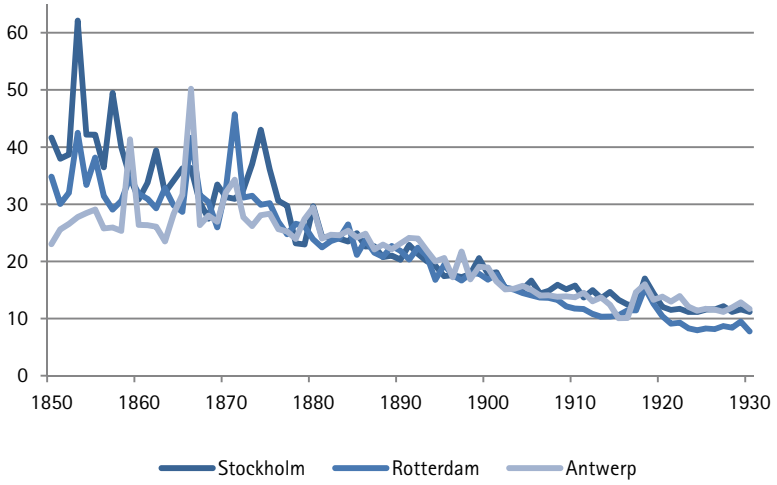
Next, the role of the early life environment will be addressed. We will examine whether rural-to-urban migrants had lower mortality risks compared to research persons who were born in a city. We expect this to be the case since the countryside was a healthier environment than the city, at least until major infrastructural works were completed (not before the latter quarter of the nineteenth century). Consequently, migrants who grew up in a rural environment (during the early period of study) experienced, on average, less disease in childhood which is believed to have resulted in higher survival rates in later life. However, at the same time rural-to-urban migrants are believed to have been more susceptible to epidemic diseases, as they had less opportunity to become immune during childhood. Following the argumentation of Alter and Oris (2005), we expect rural-to-urban migrants to have had higher mortality risks during major epidemic outbreaks which, at the same time, would have at least weakened the healthy migrant effect during epidemic years, if not making it disappear entirely. For the same reason, we expect the healthy migrant effect to have been strongest during the third phase of the epidemiological transition when epidemics were no longer a major cause of death. Finally, we expect a stronger healthy migrant effect among migrants who moved at a later stage in their life, since they were exposed to the unhealthy environment of the city for a shorter period of time. At the same time, the fact that they were still able to move at a later age suggests that they were particularly healthy (positive selection effect).

Finally, we investigate whether certain groups of migrants were confronted with such a far-reaching form of social exclusion that their health advantage was reversed into a health disadvantage. We test several interactions to see if we can identify certain (sub-)groups of migrants with excess mortality. In order to get a better idea about the level of social inclusion, we will also compare the different effects of misfortune on the life of migrants and natives. We expect that migrants would be hit harder by setbacks in life than natives, since the former more often lacked a (larger) social network of family and friends in the city of settlement who could assist them and take care of them. In order to test this, we look at the effect of becoming widowed or divorced. It is expected that the loss of a partner has a more dramatic effect on the mortality risk of migrants than on that of natives, because of the supposed lack of a social network. In addition, migrants might have had worse chances of receiving assistance from the authorities, especially for non-nationals, and their chances of repartnering were most likely also lower.

4. Setting

All three cities in this study – Antwerp, Rotterdam, and Stockholm – were port cities, experienced considerable population growth, and enjoyed a high turnover of migrants during the period of observation (Puschmann et al. 2015). In terms of mortality, a similar development is observed (see Figure 1). In the middle of the nineteenth century the crude mortality rates still had high peaks in certain years due to major epidemics. From about 1880 on, mortality rates became more stable as the frequency and effects of epidemics diminished. The 1918 flu pandemic (Spanish Flu) is the last observed major epidemic outbreak. Striking is the way how mortality declined more or less at exactly the same pace in all three cities in the half a century between 1880 and 1930.

Figure 1: Crude Death Rates in Antwerp, Rotterdam, and Stockholm, 1850-1930

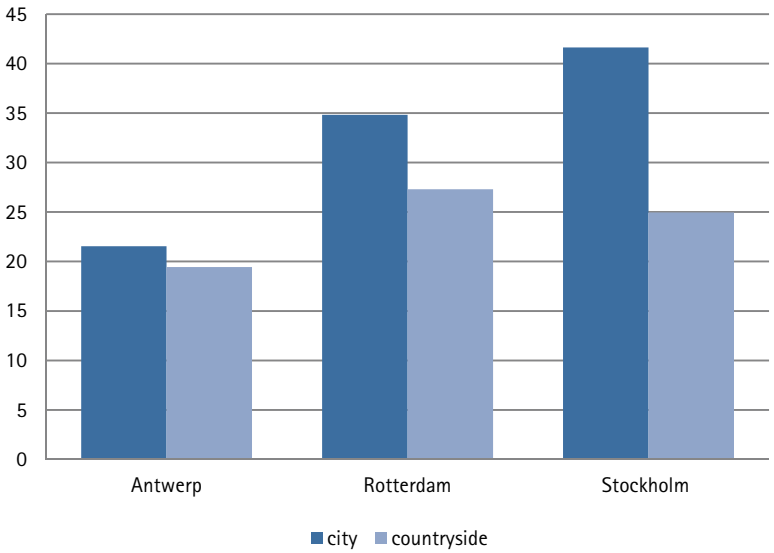


Source: Antwerp (1850-1880: Kruithof 1964; 1880-1930 LOKSTAT); Rotterdam: Historical Database of Dutch Municipalities (HDNG); Stockholm: Statistical Yearbooks of Stockholm.

In 1850, the environments of Antwerp, Rotterdam, and Stockholm were still very unhealthy in the sense that urban mortality exceeded mortality levels in the surrounding countryside (see Figure 2). While the rural-urban divide in Antwerp was relatively small, in Rotterdam and, especially, in Stockholm it was large. The most logical explanation for this divide is related to differences in population density and sanitation. However, differences in industrialization might play a role too since industry caused severe air and water pollution (Mosley 2001; Stradling and Thorsheim 1999). Antwerp, which in 1850 had the lowest crude death rate and the smallest rural-urban divide, lacked major industries, while

Rotterdam and especially Stockholm were gradually turning into industrial hot spots. Since the urban-rural divide was smaller in Antwerp, we expect the healthy migrant effect to have been less pronounced in the Belgian port city compared to Rotterdam and Stockholm given that differences in the early life environment between migrants and natives seem to have been rather modest.

Figure 2: Crude Death Rates in the City and the Surrounding Rural Environment, 1850*



Source: Antwerp: LOKSTAT, Rotterdam: Historical database of Dutch Municipalities; Stockholm: Tabell-Commissionens Underdåniga femårsberättelse till Kongl. Maj:t om Folkmängden I Sverige vid slutet af år 1850 samt Födde, Döde, Vigde m. m. I riket åren 1846-1850, med tillhörande bilagor och 53 tabeller, afgifven d. 20 April 1854 (Stockholm: Norstedts 1854), Bilaga Litt. A.
* Countryside includes in the case of Antwerp all rural municipalities of the Antwerp district, in the case of Rotterdam it includes all rural municipalities of the province of Zuid-Holland. In the case of Stockholm the countryside is represented by all parishes from Stockholm county.

Differences in industrialization and economic development most likely also had an effect on the social inclusion and exclusion of migrants. Port cities are believed to have fostered social inclusion more than industrial cities during the nineteenth century, since port labor was better suited to low educated, rural migrants who were pushed from their lands by demographic pressure and agricultural crises (Winter 2009). Although all three cities were port cities, Antwerp was unique in the sense that hardly any industry took root in the Belgian city, and that its economy was completely dominated by port activities (De

Brabander 1986). For Stockholm, more or less the opposite is true, as industrialization became the driving force behind the city's economic development, while the port played a secondary role (Högberg 1981). Rotterdam was somewhere in between, since the Dutch city developed into a world port, while simultaneously important industries were being established (Van de Laar 2000). Next, Stockholm functioned as the capital, which was neither the case for Antwerp, nor for Rotterdam. Finally, Antwerp was unique in the sense that migrants occupied both core and peripheral positions in the labor market, while this was very uncommon in other port cities (Winter 2009).

5. Data and Method

5.1 Databases

For all three port cities, high-quality historical life course data are available. For Antwerp, we retrieved data from the Antwerp COR*-database (Matthijs and Moreels 2010). This is a letter sample of the population registers and the vital registration of births, marriages, and deaths for the period 1846-1920. For all people whose last name started with the letters C-O-R (and their co-resident relatives) all demographic and socioeconomic information from the registers and certificates were transcribed, stored, cleaned, and linked. Families with these surnames are representative for nineteenth- and twentieth-century Flanders. At present, the COR*-database contains life course information on more than 30,000 individuals and covers the whole Antwerp district, consisting of Antwerp city, its suburbs and the rural municipalities belonging to the district. We selected all natives and migrants who resided at one point in time in Antwerp city or its suburbs.

The data on Rotterdam is derived from the Historical Sample of the Netherlands (HSN) (Kok, Mandemakers and Bras 2009). For this research, we made use of the dataset HSN Life Courses Release 2010.01 and the HSN release DVI 2010_01_Beta. The former dataset contains life course information on 37,173 research persons (Mandemakers 2010). The research persons of that dataset are a random sample from the Dutch birth registers from the period 1812-1920, and for all selected persons an attempt was made to reconstruct the life course. The DVI dataset is a sub-dataset, which consists of four groups of migrants (consisting each of two cohorts) and their descendants who settled in the Dutch port city of Rotterdam: Germans, Italians (and Italian-speaking Swiss), and domestic migrants from the provinces of Zeeland and Noord-Brabant. For our research purposes, we selected only first generation migrants from these groups. For more information on HSN, we refer to the website of the database: <http://www.iisg.nl/hsn>. Contrary to Antwerp and Stockholm, international migrants in Rotterdam consisted exclusively of Germans, Italians and Swiss

from the Italian-speaking South of Switzerland, since data on other international migrant groups was not available in the HSN database.

The data on Stockholm were obtained from the Stockholm Historical Database (SHD). This large historical demographic database is a digitalization of the Roteman Archives. The so-called Roteman Registration System replaced the parish register in 1878; from then until 1926, a 'roteman' – a type of civil servant – registered all socioeconomic and demographic changes of the whole population in a population register in all wards of Stockholm. This register was updated yearly on the basis of a census. At the moment of the data retrieval, 23 of Stockholm's 36 wards were covered by the database digitalization. The retrieval consists of life course information on 572,350 individuals.

We constructed one individual dataset for each city with all relevant life course information and appended all three datasets to obtain a fourth combined dataset. The appended dataset contains a variable 'city' which makes it possible to differentiate between migrants and natives who lived in Antwerp, Rotterdam and Stockholm. Analyses were carried out on all four datasets.

5.2 Variables

Sex is coded as men and women. Birth year is included as a continuous variable. City is a categorical variable distinguishing between research persons who lived in Antwerp, Rotterdam, and Stockholm in the appended dataset (not included in the individual analyses). Migration status separates the research population into natives, domestic migrants, and international migrants, based on their birth place. Research persons who were born in Antwerp, Rotterdam, and Stockholm were treated as natives, persons who were born elsewhere in, respectively, Belgium, the Netherlands, and Sweden were treated as domestic migrants, while research persons who were born outside of the national borders were coded as international migrants. Birth place distinguishes between research persons who were born in the countryside and research persons who were born in a city, and a remaining group (unknown) of which their birth place was not available in the data. In this context, cities are places, which had at least 10,000 inhabitants. Distance from birth place (in kilometers) is operationalized as a categorical variable distinguishing between research persons who were born <50 km, 50-100 km, 100-250 km and >250 km away from the city in which they settled, and an 'unknown category'. The categorical variable age at arrival is comprised of three categories: <15, 15-24, 25+ and an 'unknown' category. Civil status is included as a time-varying variable and was grouped into four categories: unmarried, married, separated/widowed, and unknown. Occupation is based on the HISCO-codification and categorized into four groups: professionals, foreman and skilled, day laborers and unskilled, and an unknown category if we did not have an occupational title. The time-constant variable occupation represents the research person's job catego-

ry/position closest to age 30, in the case of in-migration, it represents the earliest occupation entered into the register. All occupational codes were coded into HISCO (Van Leeuwen, Maas and Miles 2002) and recoded into HISCLASS (Van Leeuwen and Maas 2011), a social class scheme taking several dimension (manual versus non-manual labor, skill level, supervision, etc.) of the labor associated with the occupation into account. The twelve major groups were reorganized into four categories: (1) professionals, (2) foremen and skilled, (3) day laborers and unskilled, and (4) 'unknown.'

5.3 Methodology

To get a first idea about the differences in later life (age 30+) mortality between the different cities and according to the main variables in the analysis (sex, birth year, region of birth, migration status, and age at immigration), we made use of Kaplan-Meier survival curves (results available upon request). These are nonparametric estimates of the probability of surviving at time t (Cleves et al. 2008) which measure survival chances by each individual covariate at any moment during the analysis time, but do not allow us to control for other variables.

For the multivariate event history analysis, we turn to Gompertz proportional hazard models with baseline specified as age. Gompertz models are chosen as they fit adult mortality well, specifically for ages 30-90, and allow for either increasing or decreasing hazard rates over time (Cleves et al. 2008). The Gompertz model is expressed as:

$$\mu(x) = \mu(x; a, b) = ae^{bx}$$

The a designates the mortality level at the age at which the individual starts the risk set at x =0, while b captures the mortality increase as individuals grow older (Missov, Nemeth, Vaupel, Lenart and Canudas-Romo 2015).

Our outcome variable is death at ages 30+ and relative risks were used to estimate the associations between the variables of interest and other explanatory variables. Time at risk begins at age 30 for natives and for migrants who arrived before their thirtieth birthday. For migrants who arrived at a later moment in their life course, the time at risk starts from the date of arrival at the destination. Censoring occurs if the individual left the area of observation or at the end of registration. Death is specified as the failure event. By right-censoring individuals who left the city, we reduce the risk of salmon bias to a minimum.

The original data of the three databases is stored in Microsoft Access Files. We extracted research persons who fit the study criteria for the three cities. We then 'reconstructed' life courses of migrants and natives, including the following events: thirtieth birthday, in-migration, out-migration, death, and end of registration. This information was stored in a person period file including all time-constant covariates and the time-varying covariate civil status. The event history analyses were carried out in Stata 12. First we will present the results from the combined analyses on the appended dataset in order to get a (broad) overview of

mortality differences in the three cities. Then we will focus more in depth on the three regions in individual analyses in order to dig deeper into the context-specific mortality differences among natives and migrants in these three cities.

6. Results Joint Analysis Antwerp, Rotterdam, and Stockholm

6.1 Main Effects

Table 1 shows results from three fully standardized Gompertz models using the appended dataset in which data on Antwerp, Rotterdam, and Stockholm were combined. Model I includes both sexes; model II only females and model III only males. The variable 'city' takes differences between Antwerp, Rotterdam, and Stockholm into account. All three models show a strong and significant healthy migrant effect. Both domestic and international migrants have lower mortality risks compared to natives; however, in all three models, the effect is stronger for international migrants than for domestic migrants, and international migrant women benefit from the strongest healthy migrant effect. The strongest effect is observed for international migrant women (RR=.68) and the weakest effect was found for domestic migrant men (RR=.90).

There seems to be a negative linear relationship between distance from birth place and the risk of dying: The further migrants were born from the city they moved to, the lower their mortality risk. This is at least true for the model for both sexes and for women separately. For men, the categories '<50' and '50-100' were not significant, but the effect sizes of these categories nevertheless point to a negative linear relationship.

We then move on to the early life environment. There is evidence of an urban penalty, as subjects who were born in a city had higher mortality risks than those who were born in the countryside. This result was found in the model for both sexes (5% higher risk), and for men (9% higher risk), but no significant difference was observed for women. Next, migrants who moved to Antwerp, Rotterdam and Stockholm after the age of 24 had considerably lower mortality risks compared to migrants who migrated before their 15th birthday. This result appears in all three models (strongest effect for women: RR=.68) and shows once more that living in these three cities was unhealthy, and that some kind of urban penalty existed. However, at the same time, this result supports the idea of a positive selection effect, in the sense that those migrants who (still) moved after their 24th birthday were particularly healthy. No significant differences were found for the age category of 15-24.

Table 1: Relative Mortality Risks and Standard Errors for Death at Ages 30+, All Cities

		Model I both sexes		Model II women		Model III men	
		RR	SE	RR	SE	RR	SE
Sex	Women	(ref)					
	Men	1.70***	.02				
Birth year	continuous	1.004***	.00	1.01***	.00	.99	.00
City	Antwerp	(ref)		(ref)		(ref)	
	Rotterdam	1.29***	.07	1.45***	.12	1.19*	.08
	Stockholm	1.09**	.02	1.12*	.05	1.08*	.03
Migration status	Native	(ref)		(ref)		(ref)	
	Domestic migrant	.88***	.02	.86**	.03	.90**	.03
	International migrant	.75***	.03	.68***	.04	.81***	.04
	Unknown	.49**	.12	.54	.27	.53*	.15
Urban/ rural birthplace	Rural	(ref)		(ref)		(ref)	
	Urban	1.05**	.01	1.00	.02	1.09***	.02
	Unknown	1.24***	.07	1.27**	.11	1.23**	.09
Distance from birth-place	<50 km	(ref)		(ref)		(ref)	
	50-100 km	.95+	.02	.91*	.03	.98	.03
	100-250 km	93**	.02	.90**	.02	.95	.02
	250+ km	.91***	.02	.89***	.02	.92*	.02
	Unknown	1.00	.05	1.06	.08	.95	.06
Age at arrival	<15	(ref)		(ref)		(ref)	
	15-24	.91	.06	.86	.08	.96	.08
	25+	.69***	.04	.68***	.06	.70***	.05
	Unknown	.67***	.08	.64***	.06	.71***	.05
Civil status	Unmarried	(ref)		(ref)		(ref)	
	Married	.99	.01	1.10***	.02	.88***	.01
	Divorced/ widowed	1.16***	.01	1.31***	.03	.93+	.03
	Unknown	.19***	.00	.23***	.00	.15***	.00
Occupation	professionals	(ref)		(ref)		(ref)	
	Foremen and skilled	1.10**	.04	.90	.07	1.17***	.04
	Day laborers and unskilled	1.24***	.05	1.13	.13	1.27***	.05
	Unknown	1.25***	.02	1.05	.08	1.29***	.04
Number of subjects		241,656		133,590		108 ,066	
Deaths		30,332		13,793		16,539	
Total time-at-risk (person-years)		3,751,860		2,111,968		1,639,892	

Controlled for age
Exponentiated coefficients and standard errors
+ p <0.10, * p < 0.05, ** p < 0.01, *** p < 0.001

There were also significant results for the other variables. Men had a 70% higher mortality risk than women. There was a slight positive effect for birth year in Model I (0.004%) and II (0.1%). For men (Model III) there was a nega-

tive relationship between birth year and mortality risk, but this effect was small (0.01%) and not significant. In Rotterdam, the risk of dying was considerably higher than in Antwerp. The difference was particularly high for women (45%), which might be related to child-bearing, as the fertility decline in the Netherlands started later than in most other European countries (Engelen and Hillebrand 1986). Married men had lower mortality risks (RR=.88) than single men, while the opposite was true for women (RR=1.1). Separated or widowed women had a 31% higher mortality risk than single women, while divorced/widowed men had lower mortality risk than single men (RR=.933) – of borderline significance at the 10 percent level. Finally, we found only significant results regarding occupational group for the men. As expected, the foremen and skilled men had a 17% higher mortality risk than the reference category of professionals. Casual workers and unskilled men had a 27% higher mortality risk than the professionals.

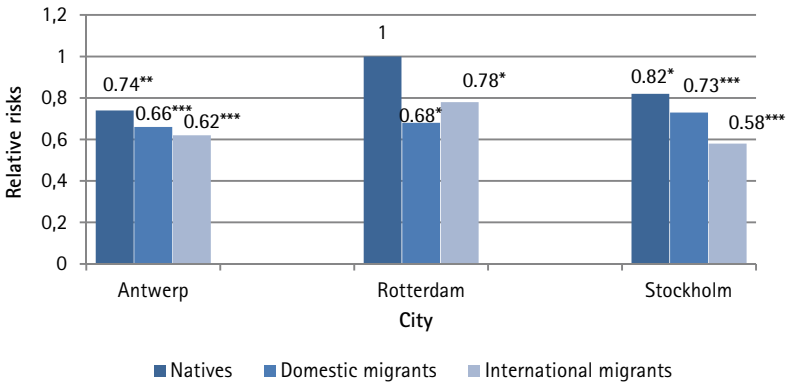
6.2 Interaction Effects

In addition to the main effects, we have tested several interactions in order to further investigate mortality risks among different migrant groups. In order to evaluate whether the healthy migrant effect existed in all three cities for both domestic and international migrants, we ran the interaction between city and migration status. Next, we wanted to test whether positive selection effects operated similarly for men and women. We evaluate this by the interactions between sex and migration and sex and distance. The interaction between migration status and marital status was run in order to see whether migrants were more adversely affected by the loss of a partner than natives. Subsequently, we investigated whether the healthy migrant effect appeared in all three phases of the epidemiological transition, by testing an interaction between migration status and period. For that specific analysis we replaced the continuous variable 'birth year' by the categorical variable 'period,' consisting of three periods, which correspond roughly to the three phases of the epidemiological transition, as distinguished by Omran (1971): 1800-1849, 1850-1909, and 1910-1930. Next, we ran the same interaction once with everybody who was born in the countryside and once with everybody who was born in a city, in order to see whether the effect of early life environment changed over time, when mortality differences between the rural-urban environment became smaller and finally disappeared or even reversed.

Figure 3 shows results from the interaction between city and migration status. This graph shows that the healthy migrant effect existed in all three cities, but that there were considerable differences in effect size between the cities and the migrant groups. In Rotterdam, the healthy migrant effect was stronger than in the other two cities. In Antwerp (RR=0.62) and Stockholm (RR=0.58), international migrants had a significantly lower mortality risk compared to the

reference category of native Rotterdam dwellers. Domestic migrants in all three cities had a lower mortality risk than Rotterdam natives, but in Antwerp and Stockholm, this effect was less strong than in Rotterdam. Moreover, for Rotterdam the healthy migrant effect was stronger for internal migrants (RR=0.68) compared to international migrants (RR=0.78).

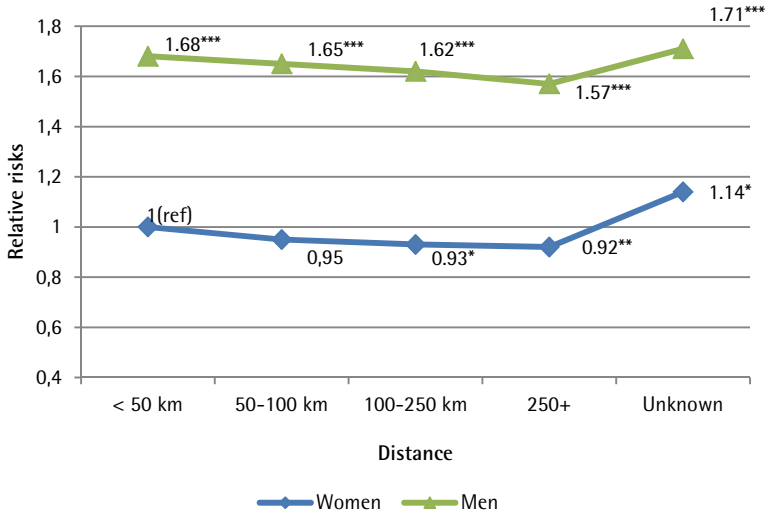
Figure 3: Relative Mortality Risks by City and Migration Status



Standardized for age, sex, urban/rural birthplace, distance from birthplace, birth year, age at arrival, civil status, and occupation.
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Figure 4 displays findings from the interaction between sex and migration distance. Women who moved less than 50 kilometers are the reference category. Our hypothesis with respect to distance is being confirmed, as both male and female migrants' mortality decreased linearly as their distance to birth place increased. With the exception of women who had moved between 50 and 100 kilometers, findings for all other groups were significantly different from the reference category, and all results fall in line with the linear trend of decreasing risks the farther the migrant had moved. Given these results, one can assume that the healthy migrant effect is indeed a result of positive selection: The further migrants had travelled, the healthier they were.

Figure 4: Relative Mortality Risks by Sex and Distance, all Cities

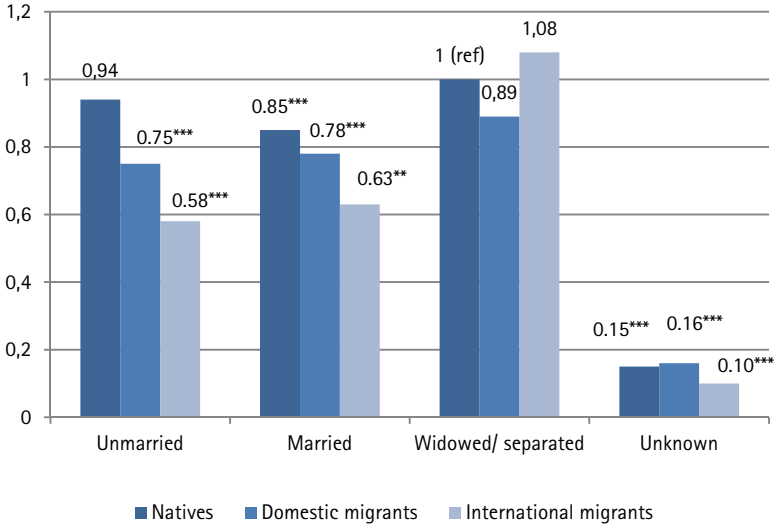


Standardized for age, urban/rural birthplace, city, birth year, age at arrival, civil status, and occupation.
+ p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001.

Figure 5 shows results from the interaction between migration status and marital status with natives who were widowed or separated as the reference category. Both being unmarried or married was associated with lower mortality risks for natives, as well as for domestic and international migrants. In the unmarried and the married categories, international migrants had lower mortality risks compared to the groups of widowed and separated natives. In line with our expectations, widowed/separated international migrants had a higher mortality risk compared to their native counterparts. While internationals were clearly adversely affected by marital disruptions (RR=1.08), they benefitted from being both married (RR=0.63) or unmarried (RR=0.58), suggesting a distinct healthy migrant effect. Although insignificant, it suggests that losing a partner had a larger (negative) impact on international migrants, suggesting that foreign migrants may have lacked a social network of friends and family who could help them in difficult times. In contrast, domestic migrants who were widowed or separated experienced lower mortality risk compared to natives from the same marital status group. This suggests that domestic migrants were less affected by the loss of a partner than international migrants. They might have had a larger social network on which they relied in times of misfortune. Friends and family might have offered them moral, financial, and practical support. At the same time, it may have been easier for domestic migrants to receive financial assistance from the municipality or the government, compared

to international migrants who might not have been eligible for government support. Finally, the chances of remarrying for international migrants were probably very limited, as the access to the marriage market for single migrants was already considerably more difficult to obtain (Puschmann et al. 2014). However, not only does the aftermath of losing a partner contribute to the elevated mortality risks of the remaining spouse. Their deaths might be also related to the common health behaviors, disease exposures, or common accidents that preceded their spouses' deaths. This can explain why widowed individuals are at the highest risks in the short-term, within up to six months after spousal loss (Martikainen and Valkonen 1996). Given that, on average, international migrants were often the healthiest, since they were able to move over longer distances to begin with, we expect that the elevated mortality risks for the widowed was related largely to the first situation – that international migrants, compared to natives and domestic migrants, faced the harshest circumstances by losing spousal and social support in their foreign land.

Figure 5: Relative Mortality Risks by Migration Status and Marital Status, all Cities



Standardized for age, city, urban/rural birthplace, distance from birth place, birth year, age at arrival, and occupation.
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The interaction between period and migration status was run separately for men and women (Appendix A). For all three periods there was a clear healthy migrant effect, and the effect was strongest for international migrants. Next, we ran the interaction between period and migration status separately for rural and

urban born dwellers (Appendix B) in order to evaluate whether there was a change in the influence of early life environment over time, as measured by birth place type. This turns out to be the case. Whereas we find a strong healthy migrant effect for all three periods for urban born dwellers, the effect was reversed for rural born dwellers during the second and third period. In other words, the rural-born advantage during the age of pestilence became a rural-born disadvantage during the 'age of receding pandemics' and 'the age of degenerative and man-made diseases'. This leads us first to conclude that being born in the countryside was only an advantage in times when cities were hit by large epidemics, and mortality was lower in the countryside. This underlines once more that low disease environment in childhood is associated with lower mortality risks in later life. Second, it is striking that the healthy migrant effect not simply becomes smaller or just disappears, but completely reverses with international rural migrants having a much higher mortality risk than natives in the last period, while the healthy migrant effect for urban born dwellers continued to exist during the second and third period. We believe that this is an indication that rural migrants faced social exclusion, as has been suggested by scholars of the Chicago School of Sociology. Once the countryside was no longer advantageous in terms of disease environment compared to the city, both domestic and international rural migrants faced excess mortality.

7. Separate Results for Antwerp, Rotterdam, and Stockholm

7.1 Main Effects

Table 2 shows separate models for all three cities. Since Stockholm is a much larger sample of research persons with more observation time and a larger number of observed deaths, we find more significant results for the Swedish capital than for Antwerp and Rotterdam.

In Rotterdam and Stockholm, we observe that domestic migrants had lower mortality risks than the reference category of natives; the effect was particularly strong for domestic migrants in Rotterdam (RR=0.63). In Stockholm, international migrants (RR=0.70) had the lowest mortality risk compared to natives. In Antwerp and Rotterdam, no significant differences are found for the group of international migrants. The absence of significant differences for domestic and international migrants in Antwerp and international migrants in Rotterdam is probably the result of a lack of statistical power, since the analyses on the appended dataset did show that a healthy migrant effect existed in all three cities.

With regard to distance from birth place, we find only significant results for Stockholm. The results suggest a positive linear relationship between the distance from the birth place and the hazard of dying. In other words, the further

away a migrant was born, the lower his/her mortality risk. This is in line with the results from table 1, suggesting that the healthy migrant effect is indeed resulting from a positive selection effect: The further migrants move, the healthier they are.

Table 2: Relative Mortality Risks and Standard Errors for Death at Ages 30+

	Model I		Model II		Model III	
	Antwerp		Stockholm		Rotterdam	
	RR	SE	RR	SE	RR	SE
Sex						
Women	(ref)		(ref)		(ref)	
Men	1.69***	.09	1.71***	.02	1.21^{+}	.12
Birth year						
Continuous	.99***	.00	1.01***	.00	1.01***	.00
Migration Status						
Native	(ref)		(ref)		(ref)	
Domestic migrant	.96	.07	.89**	.02	.63^{+}	.15
International migrant	.96	.12	.70***	.03	.83	.20.
Unknown	.60	.18	-	.02	1.01	.00
Urban/ rural birth place						
Rural	(ref)		(ref)		(ref)	
Urban	.99	.05	1.06**	.02	.91	.10
Unknown	.85	.20	1.29***	.09	1.22	.43
Distance from birth place						
<50 km	(ref)		(ref)		(ref)	
50-100 km	1.09	.09	.94*	.02	.91	.12
100-250 km	1.17	.14	.92**	.02	1.18	.19
250+ km	.90	.19	.90***	.02	1.34	.24
Unknown	.92	.15	1.00	.06	1.27	.26
Age at arrival						
<15	(ref)		(ref)		(ref)	
15-24	.89	.17	.91	.06	1.10	.40
25+	.69*	.11	.69***	.04	1.01	.37
Unknown	.86	.14	.67***	.04	.89	.33
Civil status						
Unmarried	(ref)		(ref)		(ref)	
Married	.78**	.07	.99	.01	.87	.14
Divorced/widowed	.95	.09	1.14***	.02	1.35^{+}	.24
Unknown	.05***	.00	.20***	.00	.68	.21
Occupation						
Professionals	(ref)		(ref)		(ref)	
Foremen and skilled	.85	.15	1.12**	.04	.93	.10
Fay laborers and unskilled	1.00	.18	1.27***	.05	1.05	.15
Unknown	1.02	.15	1.29***	.04	.94	.14
Number of subjects	13,674		226,114		1,907	
Deaths	1,808		27,951		573	
Total time-at-risk (person-years)	240,628		3,473,38		38,664	

Controlled for age
Exponentiated coefficients and standard errors
$^{+}$ p <0.10, * p < 0.05, ** p < 0.01, *** p < 0.001

Though no significant results were found in Antwerp and Rotterdam, in Stockholm, research persons who were born in a city had a significant 6% higher mortality risk compared to those urban dwellers who were born in the countryside, suggesting that there was only an urban penalty among migrants in Sweden. Only in Sweden was the divide in living circumstances between growing up in the countryside and a city large enough to influence later life mortality.

For Antwerp and Stockholm, migrants who arrived after their 25th birthday had lower mortality risks (for both RR=0.69) compared to migrants who arrived before their 15th birthday. This underlines the fact that living for a longer time in the city of settlement was unhealthy. However, it might more strongly signify the selectivity of migration. Migrants who were able to move after their 25th birthday were particularly robust.

Next, in all three cities men had higher mortality risks than women, although the effect was considerably smaller in the case of Rotterdam (21% versus 69% and 70%). While in Antwerp a slightly negative relationship between birth year and mortality risks is observed (RR=0.99), the opposite was true in Rotterdam and Stockholm (for both RR=1.01). The increase in adult mortality in Rotterdam and Stockholm was most likely related to the industrial revolution, which also led to temporary increases in mortality during the nineteenth century in other European cities (Bourdelais 2000). In Antwerp, city dwellers who were married had a significantly lower hazard of dying (RR=0.78) compared to the reference category of unmarried. In Stockholm and Rotterdam, research persons who were separated or divorced had higher mortality risks compared to the unmarried persons (14% in the case of Stockholm; 35% in the case of Rotterdam). With regard to profession, we found only significant results for Stockholm. In the Swedish capital, foremen and skilled workers had a 12% higher risk of dying compared to the reference category of professionals. For day laborers and the unskilled the mortality risk was 27% higher.

In addition, we aimed to evaluate whether rural migrants indeed lacked immunity against epidemics. We therefore ran the analysis on Antwerp exclusively for deaths occurring during major epidemic years (1848-1849, 1854, 1859, 1866, 1884-1886, 1894). In the years 1848, 1849, 1855, 1859, and 1866 Antwerp was hit by cholera outbreaks. In 1859 there was also malaria. In 1884 Antwerp's population was plagued by puerperal fever and smallpox; in 1885 small pox and typhus; again small pox in 1886, and measles in 1894 (Kruithof 1964). In the case study (for reference, see Appendix C) international migrants have a 17% higher mortality risk than natives, while they had lower mortality risks than natives in the main model (RR=0.96). This underlines that migrants indeed fared worse during epidemics, as they more often lacked immunity. They were so strongly hit by epidemics that the healthy migrant effect temporarily disappeared. Second, for the rural migrants the female advantage over males strongly weakened. While men in Antwerp had a 69% higher mortality risk than women in the main model (significant), this male disadvantage was

greatly reduced to only 7% higher risk in the case study for the epidemic years (although insignificant). This suggests that female rural migrants fared particularly badly during epidemics. It could be that (rural) girls were less often vaccinated than boys, as has been observed for the Netherlands (Van Poppel 2000). But the increase in mortality risks during epidemic years might have also been a consequence of the fact that the women took care of the ill and were therefore at an increased risk of getting infected (Pinelli and Mancini 1997). Finally, rural women might have been less resistant to epidemic disease, since due to their lower status in society, they had a higher risk of being underfed or undernourished (Klasen 1998).

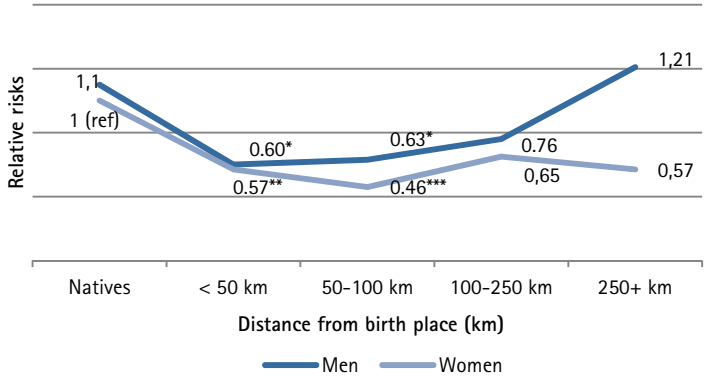
7.2 Interaction Effects

We tested several interactions in order to see whether all sub-categories of migrants experienced lower mortality risks than natives. We were able to identify two groups of migrants for which this was not the case. A first deviation from the pattern we find is in the interaction of sex and distance in Rotterdam (Figure 6). Here we do not find the same negative linear relation between migration distance and mortality, as was found in Figure 4 for the appended dataset. Both migrant men and women experience lower mortality risks compared to native men and women, but in the case of the men, the effect was strongest for those who moved less than 50 kilometers (RR=0.60). For women the effect was strongest for migrants who moved between 50 and 100 kilometers (RR=0.57). As migration distance grew, the mortality risk increased; while insignificant, for the category 250+ km, the mortality risk was considerably higher (RR=1.21) than for native men. We ran the interaction also with the migration status variable in the model. In that case, these long-distance migrants had a 63% higher mortality risk compared to the reference category of migrant men who moved less than 50 kilometers (results not shown; available upon request). The result was significant at the five percent level. Since the sample of international migrants consisted only of Germans, Italians and Italian-speaking Swiss, we know that this specific group of migrant men in Rotterdam was particularly vulnerable and disadvantaged in terms of survival chances.

For Antwerp, we find a different picture regarding the interaction between sex and distance (Figure 7). We did not find any significant results for women. Among the migrant men, mortality was lower among those who moved less than 50 kilometers (RR=1.59), compared to native men (RR=1.66). However, the category of 250+, which had increased mortality risks in Rotterdam, had much lower mortality risks in Antwerp compared to all other men in Antwerp. This suggests that international migrant men in Antwerp fared particularly well, while the group of international migrants fared particularly poorly in Rotterdam. We think that this result is less surprising than it seems at first instance. Both groups of international migrants are rather selective groups. The

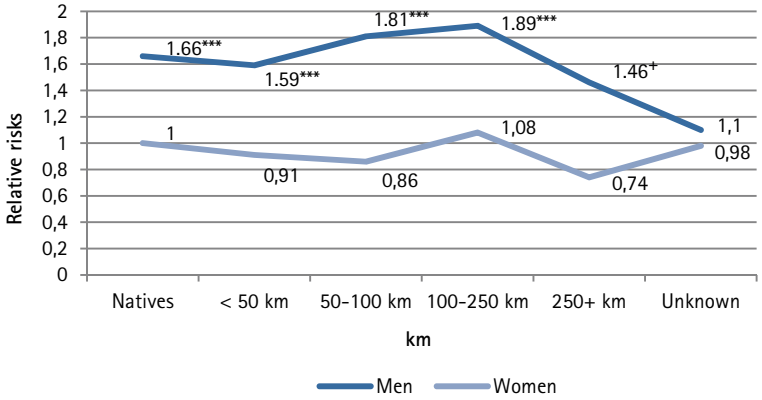
long-distance migrants in our sample for Rotterdam were Germans, Italians and Italian-speaking Swiss and, among the latter two groups, a majority was employed as chimney sweeps (37 out of the 56 registered occupations of the Italian men were chimney sweepers). The Italians and Italian-speaking Swiss dominated this sector of the economy (Chotkowsky 2006). Chimney sweeping is obviously a dirty and dangerous occupation with long-term health consequences that lead to increased mortality risks (Gustavsson, Gustavsson and Hogstedt 1988). However, at the same time the Italians, and especially the Italian chimney sweepers, were a group of chain migrants who all originated from the same area in the Swiss-Italian borderland and hardly mingled with the native Rotterdam population. The migrants were recruited by ways of a so-called padrone system, i.e. chimney sweepers with their own business in Rotterdam travelled to the Swiss-Italian borderland and recruited there their own servants. Most of them were young and had already worked as student chimney sweepers in their homeland. They were attractive, because they were physically strong, but also because their income was considerably below that of Dutch apprentices (Chotkowsky 2006). Even though they were recruited on the basis of physical strength and were able to move over long distances, they experienced excess death. Given their higher mortality risks compared to the rest of the population, a particularly strong case is made that the Italians and Swiss migrants in Rotterdam faced vast social health inequalities. German men in Rotterdam were also among the vulnerable groups, and qualitative evidence shows that they faced indeed also a certain degree of discrimination, although their career chances were rather good and they mingled to a large degree with Dutch natives (Lucassen 2004, 2005).

Figure 6: Relative Mortality Risks by Sex and Distance from Birth Place in Rotterdam



Standardized for age, urban/rural birthplace, birth year, age at arrival, marital status, and occupation.
+ p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001.

Figure 7: Relative Mortality Risk by Sex and Distance from Birth Place Antwerp



Standardized for age, urban/rural birthplace, birth year, age at arrival, marital status, and occupation.

The international male migrants in Antwerp, by contrast, were a more heterogeneous group in terms of ethnicity. Additionally, a considerable proportion of the long-distance migrant men in Antwerp belonged to the middle and higher classes. They were clerks, business men, bankers, entrepreneurs, goldsmiths, diamond workers, master mariners, engineers, or ran an independent business. These migrants played an important role in Antwerp's local economy, and rather than ending up in the second segment of the labor market, they instead performed executive functions. The opposite is true for the male medium-distance migrants in Antwerp (50-100 and 100-250km) who were also a vulnerable group of migrants with elevated mortality risks compared to the natives. These migrants were mostly domestic migrants, although there were also some Dutch, German, and French migrants among them. The occupational titles of these migrants suggest that they more often ended up in heavy port labor and construction. Accordingly, we believe that they had less human capital than the international long-distance migrants, and they lacked the social network and insider information short-distance migrants had at their disposal.

8. Conclusion and Discussion

Healthy migrant effects were present in Antwerp, Rotterdam, and Stockholm during the whole period of study. This suggests that the effect is rather universal, and can be found in different societies, for various migrant groups, in diverse mortality regimes, and at different points in time. Nevertheless, there are important variations in effect size observable between the cities and the mi-

grant groups, suggesting that contextual factors had an important impact on the differences in mortality risks and survival rates between migrants and natives. The strongest healthy migrant effect was found in Rotterdam among domestic migrants, while the health advantage for domestic migrants in Stockholm and, especially, in Antwerp was rather limited.

Findings from the multivariate analyses strongly suggest that the healthy migrant effect is at least partially a result of a positive selection effect, in the sense that migrants experience lower mortality risks than natives because only the physically and mentally fittest subjects from a sending area leave their place of origin. Generally speaking, the further migrants had moved, the lower their mortality risks. This suggests that distance functions as a second filter: Only the healthiest persons move over very long distances, because they are able to do so. Long distance migrants were thus on average physically strong persons, and at the same time also positively selected in terms of education and often moved within a network (Sewell 1985). In that sense, next to health, social and cultural resources might have contributed as well to their lower mortality risks compared to short distance migrants. Next, the later migrants moved to a city, the lower their mortality risk, suggesting that migrants who were still able to move at a later age in the life course were particularly healthy. At the same time these migrants had lived for a shorter time in the city, underlining the idea of an urban penalty.

The early life environment played a role too. Migrants who grew up in the countryside had lower mortality risks compared to research persons who were born in a city. This was most likely the case because they experienced, on average, less disease during childhood. The effect was found for the appended dataset, as well as for Stockholm, where there was a large divide in living standards between Stockholm city and the surrounding countryside, most likely caused by industrialization and bad sanitation in the Swedish capital. In Antwerp and Rotterdam, where the differences in mortality risks between the city and the surrounding countryside were smaller, no significant effect for birth place type was found. This suggests that the early life environment only seriously influences later life mortality, and by consequence the healthy migrant effect, if there were huge differences in living circumstance between the migrants' region of origin and the receiving (urban) society. In Stockholm, early industrialization, as well as high population density in combination with bad sanitation, caused such a discrepancy in living standards between rural and urban Sweden. This line of thought is also underlined by the fact that for rural-to-urban migrants in the appended dataset the healthy migrant effect turned into a 'healthy native effect' when major epidemic outbreaks belonged to the past and the rural-urban divide in mortality rates had faded away. The fact that for urban-to-urban migrants the healthy migrant effect remained during the whole period of study suggests that selection effects contributed more to the healthy migrant effect than the early life environment.

Next, in our case study, we found evidence for Antwerp that rural migrants fared particularly badly during epidemic outbreaks, and this was especially the case for rural women. This underlines the idea that rural migrants indeed lacked immunity against epidemic diseases. The fact that they had experienced less disease decreased their overall later-life mortality risks during the age of pestilence, but this made them particularly vulnerable in cities during major epidemic outbreaks. This result echoes the findings from Alter and Oris (2005) for Eastern Belgium in the nineteenth century.

We demonstrated in this article that mortality differences between migrants and natives can also be used as a heuristic tool in order to identify social exclusion among sub-groups of migrants. Since migrants under normal conditions experience a health advantage over natives due to positive selection effects, excess mortality among migrants points to vast social health inequalities between migrants and natives which are so strong that they can turn the health-advantage of being a migrant into a disadvantage. We found this to be the case for four sub-categories of migrants: (1) rural migrants during the later period of study, (2) international migrants who lost their partner, (3) Italian and Italian-speaking Swiss men in Rotterdam, and (4) medium-distance domestic migrant men in Antwerp. The first category was found for both domestic and international rural-to-urban migrants during the periods when major epidemics belonged to the past. This makes it assumable that in line with studies of the Chicago School of Sociology, rural migrants surely faced social exclusion. The second category which was also found in the appended dataset suggests that international migrants, contrary to domestic migrants, were put in an extra vulnerable position if they lost their partner. Although one can expect that the remaining spouse had been exposed to the same (adverse) environments and causes of death as their spouse, we largely believe that this was more likely due to the loss of spousal support itself. Since they often lacked a social network of family and friends who could assist them in times of trouble, and/or because they were not eligible for social support from the government since they lacked citizenship, they were more adversely impacted by partner death. Limited chances of re-marrying might have played a role too, since (a new) marriage offered protection and unmarried men and women faced elevated mortality risk during later life (Donrovich, Drefahl and Koupil 2014). In general it was more difficult for migrants to get access to the marriage market due to cultural differences and practical obstacles (Lynch 1998; Puschmann et al. 2014, 2015). Natives favored native partners and having already been married did not make these migrants more attractive in the marriage market, especially not if they had already children from a previous marriage. Accordingly, widowed and divorced international migrants faced the insecurity of living in a foreign environment (with the risk of marginalization) and the vulnerability of being unwed and the large risk of staying unwed. The third vulnerable group – the Italians and Swiss – stayed outsiders in Rotterdam, as they had limited contact outside

their own group and instead maintained their own identity and culture. More problematic was, however, their position in the labor market: A majority of the men performed a type of a job which natives deemed undesirable: chimney sweeping. This was a dirty, dangerous, and very unhealthy job. The fourth vulnerable group consisted of medium-distance male migrants in Antwerp, most of whom were domestic migrants. These men ended up more often in heavy construction work and port labor. They lacked the human capital long-distance international migrants had at their availability and the social network and insider information short-distance migrants had acquired. Consequently, they ended up in physically demanding jobs with an elevated risk of accidental deaths (cf. Lee 1999).

The fact that we did not find any distinct subgroup with excess mortality among female migrants suggests that there were gender differences in social exclusion itself, or in the effects of social exclusion. Either migrant women were less likely to remain outsiders or they paid less health costs for being socially excluded. However, at the same time we found for Antwerp that the mortality risk of women who were born in the countryside was much higher during epidemic years compared to non-epidemic years. This supposes that these rural-to-urban migrant women were hit especially hard by epidemics. One reason could be that rural girls were less often vaccinated than boys (cf. Van Poppel 2000). Elevated mortality risk during epidemics might have been also a consequence of different gender roles, since women mostly took care of diseased people, through which they became themselves at an increased risk of being infected. Last but not least, these rural-to-urban migrant women might have been less resistant to epidemics, because they were due to their lower social status believed to be less well-fed than men (cf. Klasen 1998). It was no coincidence that this effect was found among rural-to-urban migrants, since female excess mortality was strongly associated with rural areas and backgrounds (Devos 2000; Klasen 1998).

Focusing more on gender differences could be an interesting path of research for future papers on mortality differences between migrants and natives. Also, it would be informative to study whether migrants more often ended up in the most unhealthy part of the city. GIS-approaches could provide new insights into mortality differences between migrants and natives both in contemporary and in past societies.

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Appendix A

Table A1: Relative Mortality Risks by Migration Status and Period for Women, all Cities

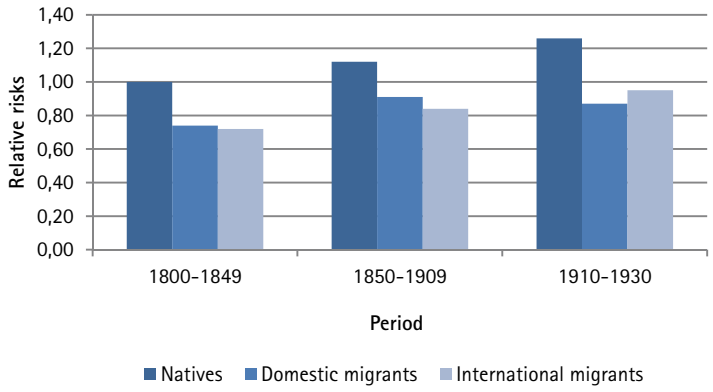
	Natives	Domestic migrants	International migrants
1800-1849	1.00 (ref)	0.79***	0.54***
1850-1909	1.07+	0.97	0.78**
1910-1930	1.40***	1.14*	0.70*

Table A2: Relative Mortality Risks by Migration Status and Period for Men, all Cities

	Natives	Domestic migrants	International migrants
1800-1849	1.00 (ref)	0.95	0.78*
1850-1909	1.27***	1.16**	0.96**
1910-1930	1.29***	1.11+	1.37**

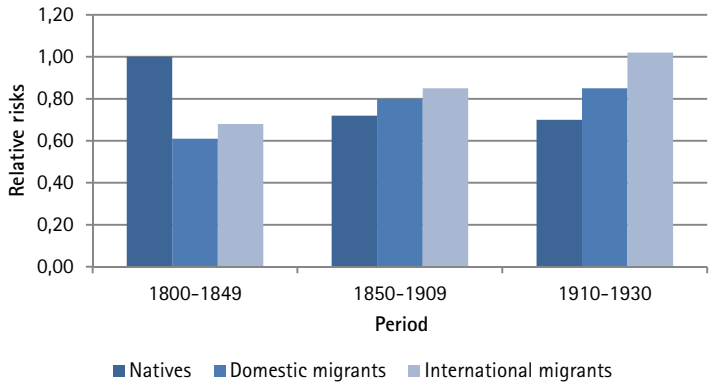
Appendix B

Figure B1: Relative Mortality Risks by Period and Migration Status for Urban Born, Antwerp



Standardized for age, sex, city, distance from birthplace, birth year, age at arrival, marital status, and occupation.

Figure B2: Relative Mortality Risks by Period and Migration Status for Rural Born, Antwerp



Standardized for age, sex, city, distance from birthplace, birth year, age at arrival, marital status, and occupation.

Appendix C

Table C: Case Study for the Rural-Born in Antwerp: Death at Ages 30+ during Major Epidemic Years (1848, 1849, 1854, 1859, 1866, 1884, 1885, 1886, 1894)

		RR	SE
Sex	Women	(ref)	
	Men	1.07	0.25
Birth year	continuous	1.02*	0.00
Migration status	Native	(ref)	
	Domestic migrant	1.02	0.31
	International migrant	1.17	0.52
	Unknown	0.99	1.15
Distance from birthplace	<50 km	(ref)	
	50-100 km	1.07	0.34
	100-250 km	1.04	0.44
	250+ km	1.03	0.62
	Unknown	0.78	0.48
Age at arrival	<15	(ref)	
	15-24	0.73	0.64
	25+	0.75	0.60
	Unknown	0.74	0.61
Civil status	Unmarried	(ref)	
	Married	0.87	0.31
	Separated / Widowed	0.86	0.34
	Unknown	1.77	0.93
Occupation	Professionals	(ref)	
	Foremen and skilled	0.53	0.29
	Day laborers and unskilled	0.74	0.40
	Unknown	0.58	0.28
Number of subjects		155	
Deaths		155	
Total time-at-risk (person-years)		880	