DEMOGRAPHIC RESEARCH
A peer-reviewed, open-access journal of population sciences

DEMOGRAPHIC RESEARCH

VOLUME 50, ARTICLE 18, PAGES 473–502
PUBLISHED 19 MARCH 2024
https://www.demographic-research.org/Volumes/Vol50/18/
DOI: 10.4054/DemRes.2024.50.18

Research Article

Mortality inequalities at retirement age between migrants and non-migrants in Denmark and Sweden

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Demographic Research: Volume 50, Article 18
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Abstract

BACKGROUND
Denmark and Sweden index their statutory retirement ages to life expectancy. When lifespan increases, so does retirement age. This policy does not consider demographic heterogeneity in life expectancy, e.g., between migrants and non-migrants, posing possible issues for pension policies that index retirement age to life expectancy.

OBJECTIVE
To understand how mortality inequalities between migrants and non-migrants interact with the indexation of statutory retirement age in Denmark and Sweden.

METHODS
We used Danish and Swedish registry data from 1988–2018, and included individuals aged 50+. Migrants were classified as European-born or non-European-born. We calculated the probability of dying before retirement age, remaining life expectancy at retirement age, lifespan inequalities after retirement age, and the likelihood that a non-migrant would outlive a migrant. We also classified the Danish-born population into four income levels and compared them to migrant groups.

RESULTS
Non-European-born migrants had the survival advantage in both countries, but equal or higher lifespan inequality at retirement. Sweden had a proportionally larger migrant population, but Denmark's was more diverse. The probability that a non-migrant would outsurvive a migrant was 40%–50% in both countries.

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CONCLUSIONS
The healthy migrant effect was observed in both Denmark and Sweden. Despite mortality advantages, migrants do not contribute to increasing life expectancy in Denmark or Sweden.

CONTRIBUTION
This study contributes to the literature on mortality differences between migrants and non-migrants in Scandinavia. The novel contributions of this paper are the consideration of the socioeconomic status of non-migrants in Denmark, and the calculation of probabilities that migrants will outsurvive non-migrants, all within the context of pension policy.

1. Introduction

In 1900, fewer than 1 in 10 inhabitants of the Nordic countries were over the age of 65. Over the next forty years, this number did not change. Today, it is 1 in 5 (Sundström 2009). As populations age, more people are reaching retirement than in previous generations, and many are living longer once they retire (Burger, Baudisch, and Vaupel 2012; Sanderson and Scherbov 2010, 2015; Vaupel, Villavicencio, and Bergeron-Boucher 2021; Zuo et al. 2018). Without intervention, this phenomenon poses a threat to the financial sustainability of pension systems. Denmark and Sweden were among the first countries in the world to address this issue by implementing a reform to index retirement age to life expectancy. As life expectancy increases, so does statutory retirement age (Whitehouse 2007). While this policy addresses some of the financial effects of aging populations on pension systems, it does not consider the heterogeneity of populations. Life expectancy differs across demographic and socioeconomic subpopulations (Vaupel, Zhang, and van Raalte 2011), and this is not reflected in Danish or Swedish pension policies.

Over the past decades, Denmark and Sweden have experienced increased immigration, which has shaped the demographics of both countries. In high-income countries, including the Nordics, most migrant groups have higher life expectancies at birth and better health outcomes than non-migrants (Deboosere and Gadeyne 2005; Guillot et al. 2018; Palloni and Arias 2004; Reiss, Spallek, and Razum 2010; Wallace et al. 2022; Wallace and Kulu 2014). As the volume of immigration continues to increase, and migrants who moved in previous waves age and transition into retirement, differences in mortality becomes a particularly pertinent topic. This raises several questions. Do migrants have higher chances of survival to retirement age, given their higher life expectancies and better health outcomes? How long do migrants live in retirement

compared to non-migrants? To what extent do migrants contribute to changes in life expectancy, and therefore the statutory retirement age? How equal or unequal are lifespans across migrant and non-migrant socioeconomic groups, and are inequalities in survival within the migrant and non-migrant subpopulations similar? How likely is it that an individual from one group will outlive someone in another?

Using population registry data from Denmark and Sweden, we aimed to answer these questions by assessing differences in survival from age 50 to retirement age (age 65) in Denmark and Sweden by migrant status, quantifying the number of years migrants and non-migrants live in retirement in Denmark and Sweden, and calculating how migrant and non-migrant groups contribute to the changing statutory retirement ages in the two countries. We illustrated how migrant groups survive compared to non-migrants across socioeconomic gradients. To provide a complete picture of the differences in the mortality profiles of migrants and non-migrants, we estimated inequalities in lifespans within those populations. Finally, to complement the inequality measure, we presented the likelihood that a non-migrant will outlive a migrant.

We have organized the remainder of the paper as follows. In Section 2, we provide the context for our analysis by explaining the recent history of Nordic migration and migrant mortality in high-income countries. In Section 3, we describe the data and summarize the methodology used in the paper. In Section 4, we show the results. Lastly, in Section 5, we conclude with a discussion of the implications of our results in the context of pension systems that index statutory retirement age to life expectancy.

2. Background

2.1 Nordic migration

Denmark and Sweden have very different migration histories, and thus migrant populations. Prior to the 1980s, Nordic migration was primarily from within the region, and primarily to Sweden. Sweden first saw an influx of immigrants from its Nordic neighbors and Germany during the Second World War, when it remained neutral, but the 1954 Common Nordic Labour Market Agreement, which allowed citizens of the Nordic countries to live and work anywhere in the region, was the main catalyst for a wave of migration to the more economically developed Sweden. The majority of migrants were low-educated workers from Finland, and it is estimated that Finnish migration to Sweden from 1954 to the end of the 1970s accounted for two-thirds of all moves within the Nordic region (Korkiasaari and Söderling 2003). Denmark, on the contrary, did not experience any such wave of migration. The largest foreign-born group in Denmark is from

Germany, though Germans have never made up such a large proportion of migrants in Denmark as Finns have in Sweden.

Migration from outside the Nordic region to both Denmark and Sweden mostly consisted of labor workers from Turkey and Pakistan and, to a lesser extent, Morocco, Yugoslavia, and India. Both Denmark and Sweden put a stop to labor migration in the 1970s, which resulted in a shift in the type of migration from these countries to that of family reunification (Bevelander et al. 2013). Since then, both countries have also received refugees, with Sweden receiving a larger proportion than Denmark relative to its population size (Karlsdóttir et al. 2018). The largest inflow of refugees after the Second World War came in the 1970s, with Chileans fleeing the military coup (Matthiessen 2009). Since then, the main origins of refugees have been Afghanistan, Eritrea, Iran, Iraq, and Somalia in the 1980s, Yugoslavia in the 1990s, and, more recently, Syria and Ukraine. Since Denmark and Sweden joined the European Union, in 1973 and 1995 respectively, and especially after the expansion of the European Union to Central and Eastern Europe in the early 2000s, the intensity of within-EU migration to both countries has increased (DeWaard et al. 2017; Ertur and Koch 2006; Favell 2008; Hrzic et al. 2021).

2.2 Migrant mortality advantage

Broadly speaking, in high-income countries migrants have a mortality advantage over non-migrants. This has been documented in many countries, including the United States (Palloni and Arias 2004), Canada (McDonald and Kennedy 2004), and European countries such as Germany (Ronellenfitsch et al. 2006), France (Boulogne et al. 2012), and the United Kingdom (Scott and Timæus 2013). However, some studies suggest that the migrant mortality advantage may not persist at older ages. For instance, Wallace and Wilson (2022) find evidence of a migrant mortality advantage at younger ages in Denmark and Sweden, but a reversal at older ages. A similar phenomenon has been observed in the United States and Canada (Palloni and Arias 2004; Vang et al. 2017).

There are four main explanations for the migrant mortality advantage: in-migration selection, also known as the ‘healthy migrant effect’; out-migration selection, also known as the ‘salmon effect’; data artifacts, including under-coverage and over-coverage; and cultural effects (Andersson and Drefahl 2017). The healthy migrant effect posits that those who immigrate to a country are inherently healthier than the receiving population. The salmon effect occurs when migrants leave a receiving country when their health declines, leaving behind a migrant population that is healthier than it otherwise would have been and which thus has a longer lifespan than it otherwise would have. Data artifacts occur when the migrant population is not accurately represented in

administrative registries, either by under-coverage (migrants are not registered when they arrive) or over-coverage (migrants are not unregistered when they leave). In the case of over-coverage, which is often caused by the salmon effect, a death or adverse health outcome would not be recorded in administrative registries, giving the impression that individuals may live longer or have better health outcomes than they actually do. Cultural effects explain any behavioral differences between migrants and non-migrants that are associated with health outcomes – smoking and alcohol consumption, for example. These explanations can exist in tandem with one another, and are supported to differing degrees in high-income receiving countries (Guillot et al. 2018).

In European receiving countries the healthy migrant effect is, generally, the accepted explanation for the migrant mortality advantage (Ichou and Wallace 2019; Wallace and Wilson 2019). The Nordic countries are no exception (Syse et al. 2016; Wallace and Wilson 2022). In addition, Dunlavy et al. (2022) find no support for the salmon effect as an explanation for the migrant mortality advantage in Sweden, although migrants from some regions with low-to-moderate levels of comorbidities had a higher risk of emigration than those with no comorbidities. Andersson and Drefahl (2017) treat long-distance migration between the northern and southern parts of Sweden as a proxy for international migration, and also find that the healthy migrant effect plays a major role in explaining the migrant mortality advantage. However, Monti et al. (2020) do find evidence for over-coverage in Sweden at ages with high-migration intensity (up to age 40), but a low impact on mortality from ages 40 to 75. The research on migrant health in Denmark is limited, especially when compared to Sweden, although studies that focus on health outcomes show a migrant advantage in Denmark (Norredam et al. 2014). Although migrants are healthier than non-migrant populations in European receiving countries, mainly due to initial health selection, Rechel et al. (2013) find that migrants may also be more susceptible to both communicable and non-communicable diseases. This is supported by Drefahl et al. (2020) and Rostila et al. (2021), who document a higher death toll in Sweden of COVID-19 among immigrants from lower- and middle-income countries.

Migrant mortality varies across the Nordic countries. While adult migrants of working age are positively selected on health, variations by origin and time have resulted in a more nuanced contribution to national life expectancy in the Nordic countries. Wallace et al. (2022) find that migrants in Denmark, Finland, and Norway increasingly enhance national life expectancy over time. By contrast, in Sweden the migrant effect has shifted from negative to positive. They posit that these shifts reflect a gradual decrease in the significance of intra-Nordic migration, which was less selected in the past, and an increase in the importance of non-Western migration. The latter group is often strongly positively selected for health in all four countries. They further argue that Sweden's distinct pattern can be attributed to its role as the primary destination for intra-Nordic

migrants up to the 1980s, and might reflect the stronger negative initial health selection among Finnish migrants to Sweden, especially among Finnish male migrants.

Based on this knowledge, and to enhance the current debate on the indexation of retirement age to life expectancy, we aim to present a comprehensive analysis of migrant mortality before and after retirement age in Denmark and Sweden. Specifically, we evaluate whether immigrants have higher chances of survival to retirement age and length of time spent in retirement compared to non-migrants, given their higher life expectancies and better health outcomes. We also calculate to what extent immigrants contribute to changes in life expectancy and therefore the statutory retirement age, and inequalities of lifespans across socioeconomic groups. The main innovations of this paper are the inclusion of the Danish-born socioeconomic gradient into the mortality analysis, and the application of the outsurvival statistic to understand the probabilities of migrants outsurviving non-migrants.

3. Data and methods

3.1 Data

We used registry data from Denmark for the years 1988 to 2018, and from Sweden for 1991 to 2018. We aggregated data on individual demographic and socioeconomic characteristics. Data were acquired through Statistics Denmark and Statistics Sweden, the two national authorities on population statistics and data. The study population included all individuals who were registered as resident in Denmark or Sweden during the entire study period, aged 50 years or older. We used country of birth as a proxy for migrant status. We differentiated between three subpopulations: (1) non-migrants, defined as those born in the host country, either Denmark or Sweden, (2) European migrants who were born in other European countries excluding the host country, and (3) migrants born outside Europe. In the Supplementary Material we also present results for non-migrants compared to the combined group of all migrants who were born outside the host country. We used age 65 as a proxy for the statutory retirement age. The statutory retirement age in Denmark for the majority of the study period was 65 years. Although statutory retirement age in Sweden was lower, around 63 years, the average age of actual retirement was around 65 years (OECD 2023).

We also used equivalized disposable family income as a proxy for the socioeconomic status (SES) of non-migrants in Denmark (Eurostat 2021). Analyzing the Danish-born population by SES allowed us to understand how foreign-born groups compared to different segments of the Danish-born population, and thus gave a more nuanced understanding of mortality differences between those foreign- and native-born.

This variable was calculated by adding pre-tax income and imputed hypothetical rent (for homeowners), and subtracting interest expenses, taxes, etc. The final amount was divided by the number of equivalent adults living in the household to reflect its size and age composition. To calculate the number of equivalent adults, weights were applied to all members of the household, with a factor of 1 for the first adult, 0.5 for the second adult and each subsequent person aged 14 or older, and 0.3 for each child under the age of 14. Those born in Denmark were then divided into quartiles according to income distribution, computed by year, sex, and 5-year age classes until age 89, and an open age category 90 and older. Data for migrants were not sufficient to similarly classify them by SES using the same method.

3.2 Analysis

We computed period life tables by year, sex, and migrant status for Denmark and Sweden using aggregated data from population registries. Exposures were obtained as the average population alive between two calendar years. For this reason, and reflecting the data availability in both countries, our results refer to the period 1988 to 2018 for Denmark and 1991 to 2018 for Sweden.

Based on the life tables, we computed the probability of dying between ages 50 and 65 by sex, for each year of the study period by migrant background. We estimated life expectancy at retirement to quantify the average number of years these groups would spend in retirement. Based on these estimates, we quantified the differences between length of life spent in retirement for migrants and non-migrants. Calculating remaining life expectancy at retirement can inform pension policy reforms that aim for intergenerational fairness, whereby younger cohorts spend an equal proportion of their lives in retirement as previous cohorts (Alonso-García, Boado-Penas, and Devolder 2018; Hassler and Lindbeck 1997).

We also quantified inequalities in lifespans between migrants and non-migrants by year, sex, and migrant background using two indicators. We calculated e-dagger ($e^{\dagger}$) at age 65 to summarize years of life lost, on average, to death from age 65+ (Vaupel and Canudas-Romo 2003), as follows:

$$e^{\dagger} = \sum_{x=65}^{\omega} d(x)e(x),$$

where $d(x)$ is the life table deaths at age x and $e(x)$ is the remaining life expectancy at age x, conditional on surviving to age 50. This formula was applied to all subpopulation groups.

We also calculated a discrete version of the outsurvival statistic (φ) to quantify the probability that a non-migrant would outsurvive (i.e., live longer) a migrant, conditional on surviving to age 50 (Bergeron-Boucher et al. 2022), as follows:

$$\varphi \approx \sum_{x=50}^{\omega} d^2(x-1)l^1(x) + \frac{\sum_{x=0}^{\omega} d^1(x)d^2(x)}{2},$$

where $d(x)$ is the life table deaths at age x and $l(x)$ is survival probability at age x. In this paper we conducted the following comparisons of populations: those foreign-born compared to native-born in Denmark, those foreign-born compared to native-born by each income quartile in Denmark, and those foreign-born compared to native-born in Sweden.

To complement these analyses, we also classified the Danish-born population by income quartile to represent four levels of SES. We applied the methods described above to compare the Danish-born population by SES with the migrant population by background (European or non-European). Lower SES is associated with higher risk of death before age 65 in Denmark (Strozza et al. 2022), and these analyses provide more context for migrant survival in the Danish case. All analyses were done in R version 4.2.2 (R Core Team 2022).

4. Results

4.1 Comparing survival to and after retirement age in Denmark and Sweden

The composition of the migrant populations in Denmark and Sweden provides context for interpreting the results of our mortality analysis. In Table 1 we present descriptive results that display the top five countries of birth among migrants aged 50 and older in Denmark from 1988 to 2018, and in Sweden from 1991 to 2018, in 10-year increments. The foreign-born populations of those aged 50 and older in both Denmark and Sweden grew over this time period. Migrants comprised 3.8% of the Danish population aged 50+ in 1988, which grew to 8% in 2018. Germany was consistently the top country of origin for migrants in Denmark aged 50+ across the entire study period. However, the proportion of German-born migrants aged 50+ shrunk over time, from 15.6% in 1988 to 8.7% in 2018, illustrative of the increasing diversity of the older migrant population in Denmark. The percentage of migrants aged 50+ born outside the top five sending countries increased from 53.4% in 1988 to 69.5% in 2018. In Sweden, migrants aged 50+ represented 8.7% of the total population at the beginning of the study period (1991),

which increased to 15.9% at the end. Finland was consistently the top country of origin for migrants aged 50+ in Sweden, representing about one-third of the older migrant population over the last 20 years. However, as opposed to what we observed in Denmark, the percentage of migrants aged 50+ born outside the top five sending countries reduced from 42.7% in 1991 to 32.2% in 2018, indicating a decrease in the diversity of the older migrant population in Sweden.

Table 1: Top 5 countries of origin for migrants, percentage European-born, and percentage foreign-born in Denmark and Sweden among those aged 50 years or older, 1988–2018

	Denmark		Sweden	
Year	**Country**	**%**	**Country**	**%**
1988/1991*	Germany	15.6	Finland	28.4
	Sweden	9.5	German-speaking countries	9.2
	Turkey	9.0	Norway	8.2
	Norway	7.6	Denmark	7.2
	United Kingdom	4.9	Former Yugoslavia	4.4
	All Europe	70.6	All Europe	89.2
	% foreign in 50+ population	*3.8*	*% foreign in 50+ population*	*8.7*
1998	Germany	11.0	Finland	33.0
	Turkey	8.2	German-speaking countries	9.4
	Sweden	6.7	Norway	7.5
	Norway	5.6	Denmark	7.0
	Bosnia and Herzegovina	5.2	Former Yugoslavia	6.6
	All Europe	63.4	All Europe	86.2
	% foreign in 50+ population	*5.6*	*% foreign in 50+ population*	*10.3*
2008	Germany	9.6	Finland	36.3
	Turkey	7.9	Former Yugoslavia	9.2
	Sweden	5.8	German-speaking countries	8.8
	Norway	4.9	Norway	7.2
	Bosnia and Herzegovina	4.9	Denmark	6.8
	All Europe	59.6	All Europe	77.2
	% foreign in 50+ population	*6.9*	*% foreign in 50+ population*	*12.7*
2018	Germany	8.7	Finland	31.9
	Turkey	7.3	Former Yugoslavia	11.7
	Sweden	5.2	Iraq	8.7
	Poland	5.0	German-speaking countries	7.8
	Bosnia and Herzegovina	4.3	Iran	7.7
	All Europe	58.2	All Europe	62.4
	% foreign in 50+ population	*8.0*	*% foreign in 50+ population*	*15.9*

Note: *The study period begins in 1988 for Denmark and 1991 for Sweden. German-speaking countries include Austria, Germany, and Switzerland. Former Yugoslavia includes Bosnia and Herzegovina, Croatia, Kosovo, North Macedonia, Montenegro, Serbia, and Slovenia.

In Figure 1, we present the probability of dying between ages 50 and 65 for migrants and non-migrants in Denmark (panel A) and Sweden (panel B) between 1988 and 2018 by sex. Migrants were divided into two categories, those born in and outside Europe (see the Supplementary Materials Figures S6-S9 for the comparison of the combined migrant subpopulation and the non-migrant population). From 1988 to 2018 there was a clear and consistent reduction in mortality in both countries, across all groups. In Denmark, migrants from outside Europe experienced lower probabilities of dying before reaching age 65 for both sexes. Among men, European migrants and non-migrants had similar mortality levels until the mid-2000s, but they have been consistently lower since then. Among women, European-born women had lower levels of mortality in Denmark. In Sweden, European migrants had higher mortality between ages 50 and 65 than non-migrants among both men and women, with the former showing greater inequalities than the latter. Similar to Denmark, Swedish non-European migrants had the lowest mortality levels, but the magnitude of these inequalities was lower.

Figure 2 depicts remaining life expectancy at retirement age for migrants (European and non-European) and non-migrants in Denmark (panel A) and Sweden (panel B) between 1988 and 2018 by sex. Over the study period, life expectancy at retirement age increased for all groups. In both Denmark and Sweden, and for men and women, migrants born outside Europe had the highest remaining life expectancy at retirement for most of the study period. On the other hand, European-born migrants fare very differently in Denmark and Sweden. In Sweden, remaining life expectancy at retirement age was higher than that of the Danish population overall for most of the study period among both men and women (Kashnitsky 2023). Figure 3 further illustrates these findings by displaying the differences in years in life expectancy at retirement for migrants and the non-migrant population compared to Denmark and Sweden overall. Non-European migrants had an average of two to three years longer remaining life expectancy than the general population in Denmark, and one to two years in Sweden.

Figure 4 presents years of life lost due to death as ages 65+ for European and non-European migrants and non-migrants in Denmark and Sweden between 1988 and 2018. Exploring lifespan inequality in addition to changes in life expectancy estimates adds valuable insights into the survival differences between the analyzed subpopulations. The estimates of lifespan inequality at retirement for European and non-European migrants are much noisier than for non-migrants due to the differences in the sizes of these sub-populations. In Denmark the levels of lifespan inequality for migrants are similar to the overall level in Denmark for men, and slightly lower for women. In Sweden, contrary to what is observed for Denmark, lifespan inequality for the two migrant groups was higher than that of the total population, which reflects a greater variability in their ages at death. This indicates that migrant populations in Sweden are more heterogeneous than in Denmark. Notably, non-European migrants had longer lives but more variability in their

ages at death once they reached retirement age, and the general trend of reductions in lifespan inequality is less clear for non-European migrants in Sweden.

Figure 1: Probability of dying between ages 50 and 65 for migrants and non-migrants in Denmark (panel A) and Sweden (panel B) between 1988 and 2018, stratified by sex

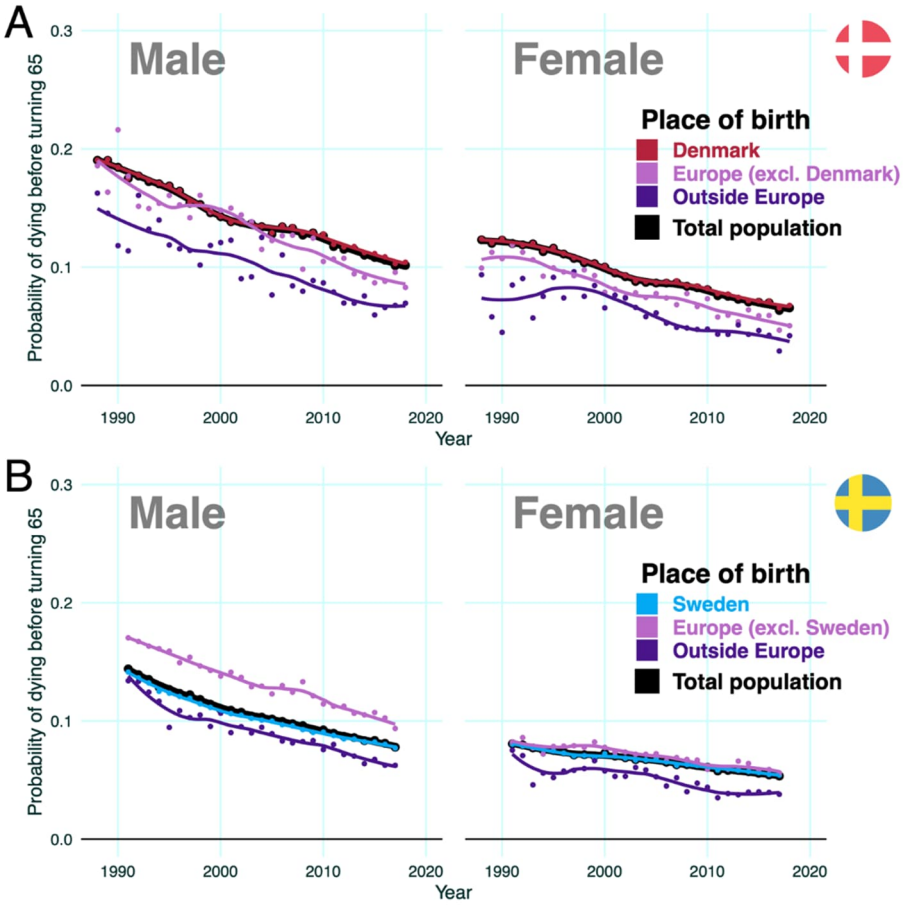


Figure 2: Remaining life expectancy at retirement age (65 years) for migrants and non-migrants in Denmark (panel A) and Sweden (panel B) between 1988 and 2018, stratified by sex

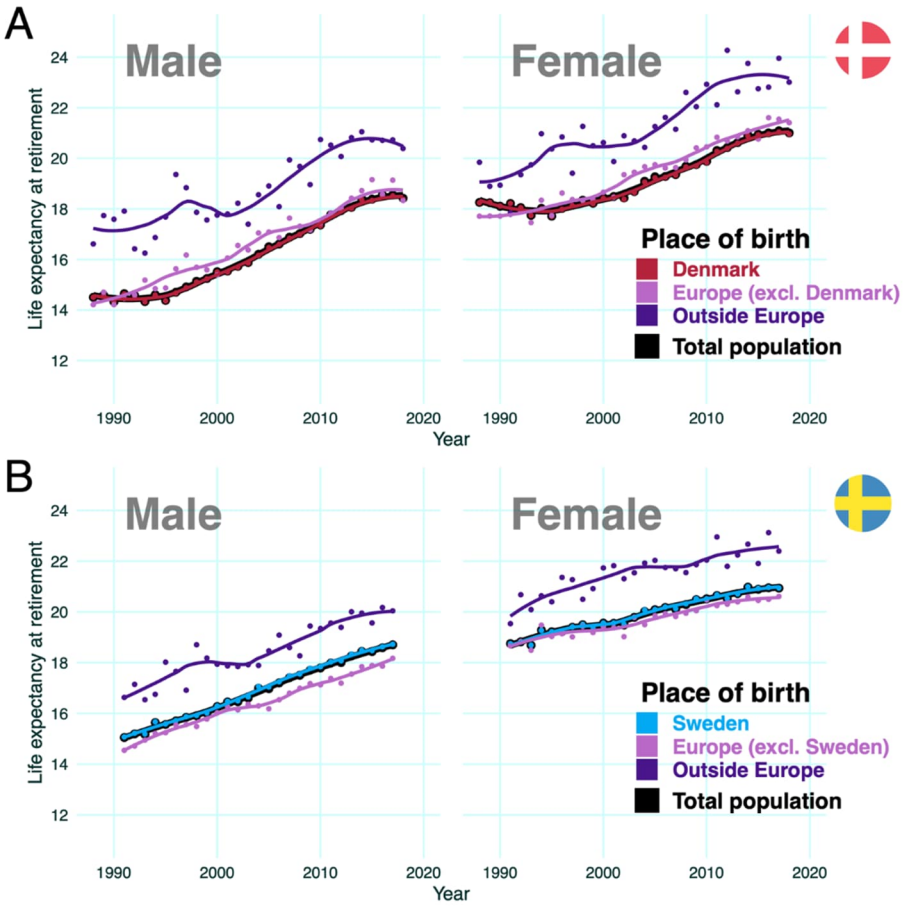


Figure 3: **Differences (in years) between life expectancy at retirement age (65 years) for Denmark (panel A) and Sweden (panel B) overall compared to migrants and non-migrants between 1988 and 2018, stratified by sex**

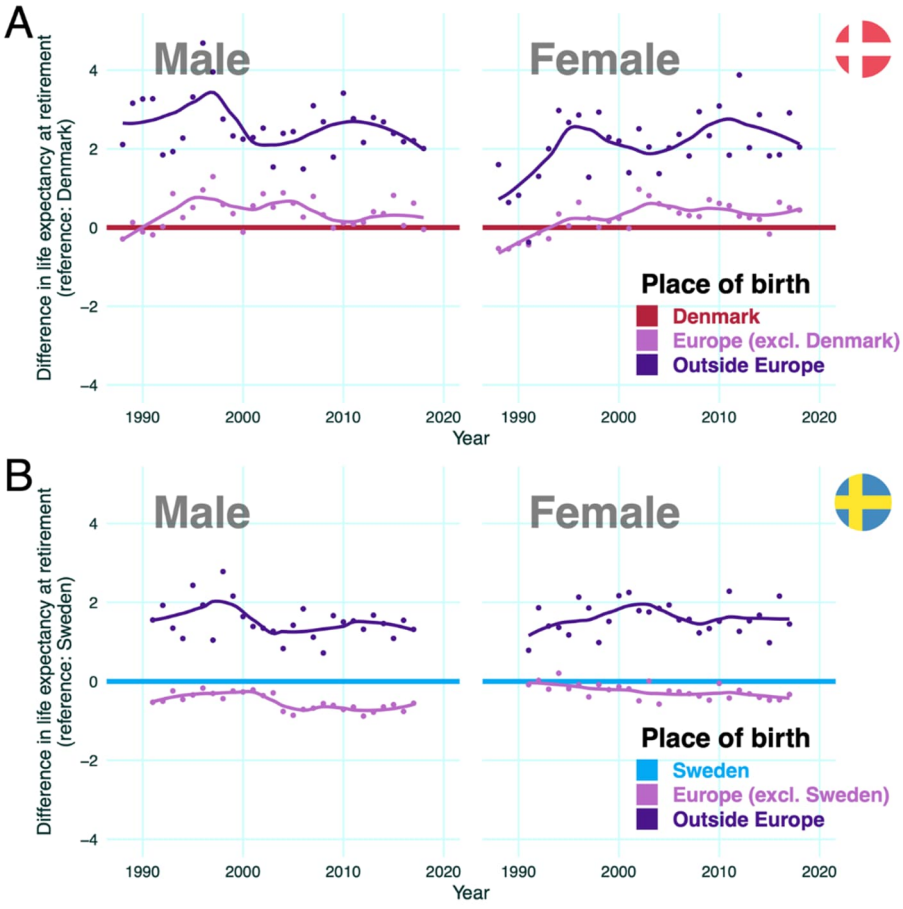
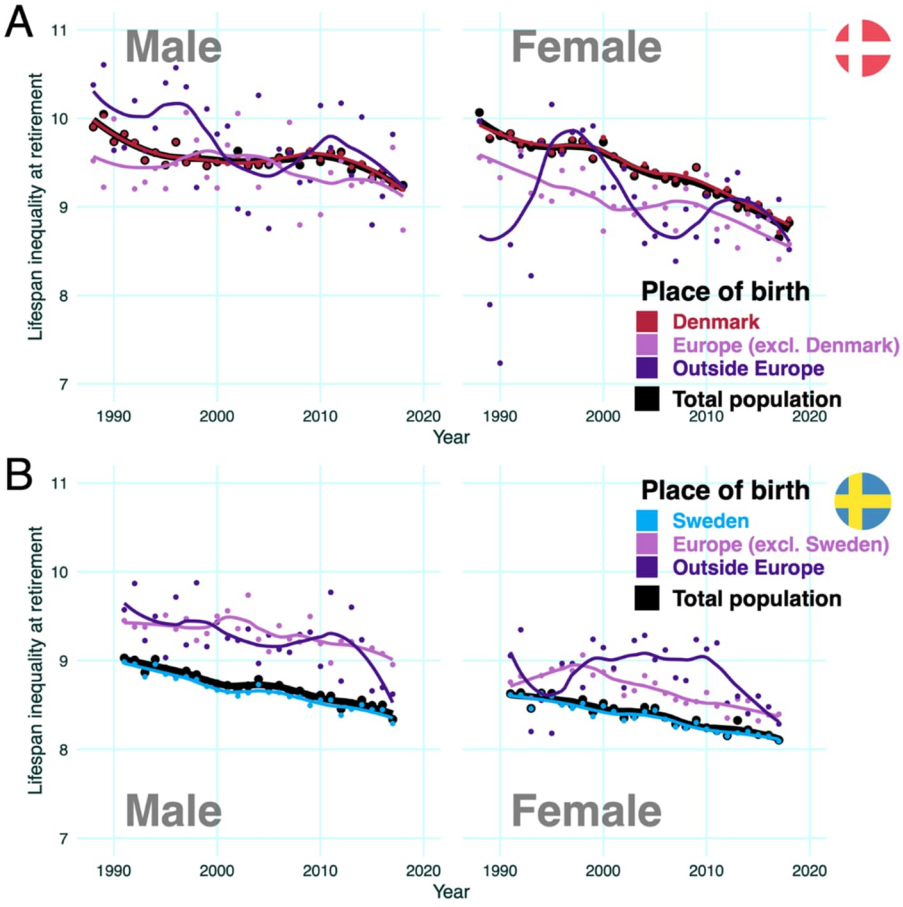


Figure 4: **Years of life lost due to death from retirement age (65+ years) for migrants and non-migrants in Denmark (panel A) and Sweden (panel B) between 1988 and 2018, stratified by sex**



4.2 Comparing migrants in Denmark with different levels of SES in the Danish-born population

Figures 5 and 6 give more context to the Danish results by classifying the Danish-born population by income quartile to represent SES. We calculated the probability of dying between ages 50 and 65 (Figure 5), remaining life expectancy at retirement age (Figure 6, panel A), differences in remaining life expectancy at retirement age with Denmark as the reference group (panel B), and lifespan inequalities at retirement age (panel C). Panel A reveals an exception to the clear decline in mortality depicted in Figure 1. Non-migrants in Denmark (both men and women) in the lowest income quartile saw almost no improvements in mortality. European migrants had mortality levels that closely resembled those of non-migrants in the second and third income quartiles among men, and close to the third income quartile among women. Non-European migrants had even lower levels of mortality in Denmark, comparable to those of non-migrants in the third income quartile among men and fourth (highest) among women. Panel B shows that life expectancy of European-born migrants was higher than the first three income quartiles of the Danish-born population, but lower than that of the fourth (highest) quartile. Panel C reveals that in Denmark, lifespan inequality is greatest in the lowest Danish-born SES group. Moreover, this is the only group that experienced an increase in lifespan inequality over the course of the study period, which is seen for both men and women (Strozza et al. 2022). By contrast, the two highest Danish-born SES groups saw a sharp decrease in years of life lost in retirement.

Figure 5: Probability of dying between ages 50 and 65 between 1988 and 2018 in Denmark by income quartile, stratified by sex

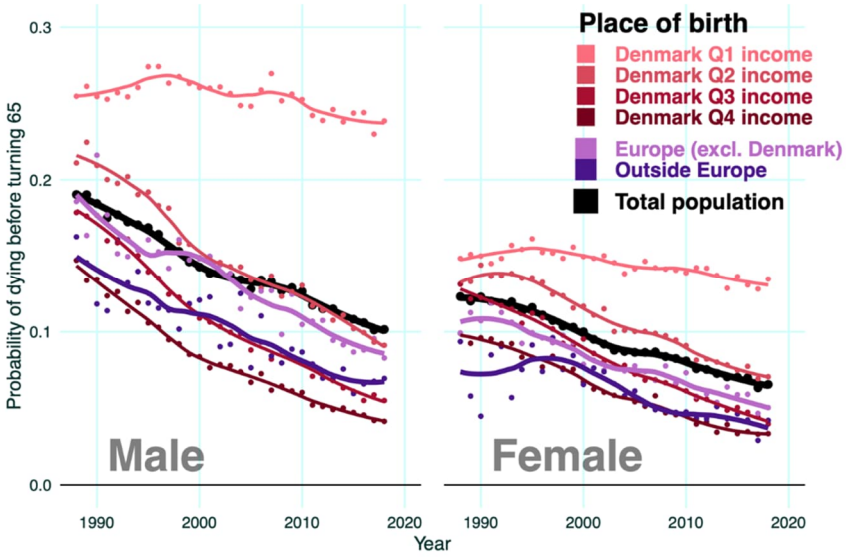


Figure 6: **Remaining life expectancy at retirement age (panel A), differences in life expectancy at retirement with reference: Denmark (panel B), and years of life lost due to death from retirement age (65+ years) (panel C) between 1988 and 2018 in Denmark by income quartile, stratified by sex**

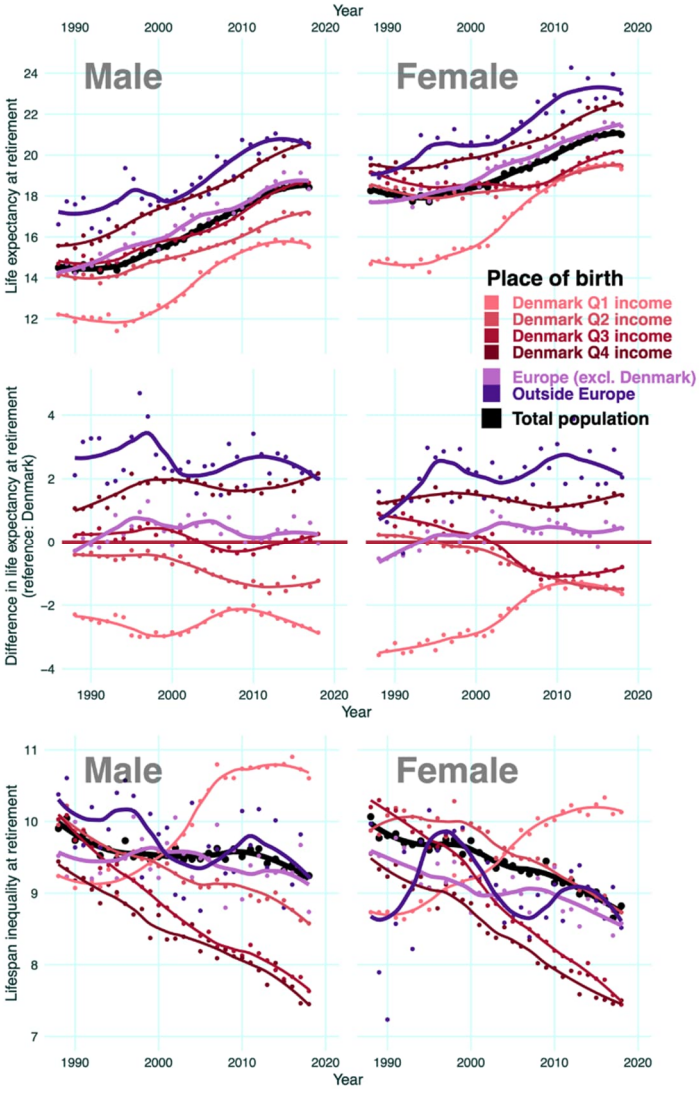
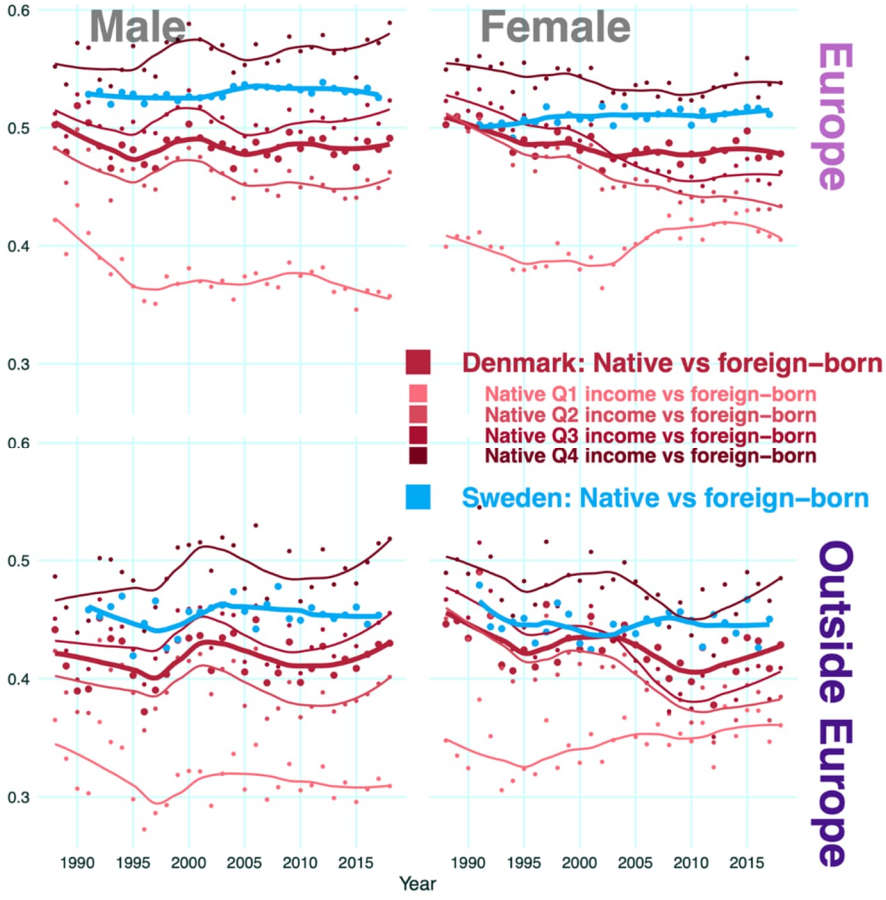


Figure 7 shows the probability that a randomly selected non-migrant would outsurvive a migrant for the periods 1988 to 2018 in Denmark and 1991 to 2017 in Sweden. These probabilities largely agree with two previously identified regularities. First, migrants from other European countries have lower mortality than the native-born in both Denmark and Sweden, with the opposite being true for non-European migrants. Secondly, the outsurvival probabilities remained roughly constant over time in Sweden and for Danish-born men, and reduced slightly for Danish-born women. This reduction, however, did not happen equally along the SES gradient, and was mostly driven by dynamics in the middle of the income distribution. Probabilities for the richest and poorest quartiles also remained roughly constant.

The outsurvival statistic offers a more holistic perspective on the pairwise comparison of subpopulations' mortality, since it considers both central estimates and variances. The actual values of the outsurvival statistic are less telling than their development over time. The dominating constant probabilities signal that there is an agreement between the dynamics of life expectancy and lifespan variation in the compared subpopulations. The reducing outsurvival probabilities that we observe for middle-income women are primarily driven by the faster-reducing lifespan inequalities in these population groups (Figure 6C).

Figure 7: **Probability that a non-migrant in Denmark and Sweden will outsurvive a migrant after reaching retirement (age 65) between 1988 and 2018, stratified by sex. Non-migrants in Denmark are split into income quartiles**



5. Discussion

The guiding aim of this paper was to understand how inequalities in mortality between migrants and non-migrants interact with the indexation of the statutory retirement age in Denmark and Sweden. We compared migrant and non-migrant survival to retirement age, quantified the number of years migrants and non-migrants lived after retirement age, estimated their inequalities in lifespans, and calculated the probability that non-migrants would outsurvive migrants once they had survived to retirement age.

Adult migrant populations of those aged 50 and older are structurally different in Denmark and Sweden, which largely explains the different mortality patterns. Denmark's migrant population of those 50+ is primarily German-born, while Sweden's is primarily Finnish-born. At the outset, large migrant populations from neighboring countries do not seem particularly noteworthy, but these populations are represented very differently in the results of this study. First, the proportion of German-born migrants in Denmark shrunk over the duration of the study period from 15.6% of the migrant population aged 50+ in 1988 to 8.7% in 2018. Finnish-born migrants, on the other hand, made up 28.4% of the migrant population aged 50+ in Sweden in 1991, which increased to 31.9% in 2018. The 1954 Common Nordic Labour Market Agreement saw an influx of low-educated migrants from Finland to Sweden, accounting for an estimated two-thirds of all moves within the Nordic region from 1954 to the end of the 1970s (Korkiasaari and Söderling 2003). Throughout this period, Finns who moved to Sweden moved for labor opportunities. In the 1950s a large proportion of Finnish migrants to Sweden had worked as farm or forestry laborers in northern Finland, a region of high unemployment and out-migration, and although only around 30% of Finnish migrants in Sweden had industrial experience, more than two-thirds ended up working in the industrial sector. In 1970, around 70% of Finns in Sweden were employed in the production sector performing physically demanding work under difficult conditions with regards to heat, noise, and risk of accidents (Hammar 1995). In our analysis, we found that in Sweden, European-born migrant men had the highest probability of dying before reaching age 65 and the lowest remaining life expectancy at retirement when compared to those born in Sweden, outside Europe, and overall. These results are in line with those of other researchers who study the mortality disadvantage of the Finnish-born population in Sweden (Honkaniemi et al. 2017). To our knowledge, there are no studies that focus specifically on the German-born migrant population in Denmark, but our results indicate that mortality among German-born migrants is more aligned with that of the Danish population. That said, the diminishing proportion of Germans within the migrant population could contribute to this conclusion. Although the migrant population in Denmark is proportionally much smaller than that of Sweden, it is more diverse. In 2018, 30.5% of Denmark's migrant-born population aged 50+ came from one of the top five countries of origin, with no one

country representing more than 10% of the older migrant population, whereas in Sweden, 67.8% of the migrant population aged 50+ came from one of the top five countries of origin, with Finns representing about a third of all migrants in this age group. Changes in the composition of the migrant populations over time could have affected life expectancy. In our analyses we studied European and non-European migrant groups, but did not take compositional changes over time into account. Additionally, while we only considered country of birth as an indicator of migrant status and not the country of birth or citizenship of parents, we do not believe this affected our results.

A novelty of this study is the introduction of the Danish-born SES gradient into the analysis of the non-migrant population mortality. When compared to the different socioeconomic levels of non-migrants in Denmark, migrants, specifically those born outside Europe, had a probability of dying before age 65 that was more aligned with the highest socioeconomic groups in Denmark, i.e., among the lowest probabilities. Non-European migrants also had the highest life expectancy at retirement for both men and women, comparable to that observed in the wealthiest Danish-born SES group. This result confirms the existence of a prominent healthy migrant effect in Denmark, consistent with other studies that find similar evidence of this phenomenon in the Nordic region (Andersson and Drefahl 2017; Syse et al. 2016; Wallace and Wilson 2019). Although we are not able to completely exclude the existence of potential biases in our analysis, particularly with regards to out-migration selection, these results suggest that in the context of mortality, migration acts against the negative effect of being less educated or having a lower income, especially for those born outside Europe. That said, Statistics Denmark has reported that there is no evidence of data artifacts, either by under-coverage or over-coverage, in Danish registry data (Danmarks Statistik 2020). Denmark and Sweden both require all residents to be included in their respective population registries. From a research perspective, Danish and Swedish registry data are thus of very high quality (Andersson, Monti, and Kolk 2023; Schmidt et al. 2015). In Sweden there is evidence of over-coverage among migrants in the Swedish registry data for those up to age 40, but the impact on mortality estimates at ages 40–75 is low (Monti et al. 2020). However, not all data are directly comparable, and a limitation of this study is that we could not perform the same analyses by SES for Sweden due to the inconsistency of equivalized family income measures in the Swedish registry data.

The estimates of lifespan inequality at retirement for European and non-European migrants are noisy but it seems to hover around the overall level in Denmark. Results for non-European migrants in Sweden also lend support to the healthy migrant effect in this migrant population, consistent with Wallace and Wilson (2022), who came to the same conclusion using different methods. The non-European migrant group had the lowest probability of dying before age 65 and the highest life expectancy at retirement, yet at the same time their lifespan inequality at retirement was higher than that of non-migrants. A

higher level of life expectancy usually corresponds to lower levels of lifespan inequalities (Aburto et al. 2020), and this result may reflect a greater heterogeneity among the migrants from outside Europe. One possibility is that migrants have a different cause-of-death profile that might lead to higher lifespan inequalities (Aburto and van Raalte 2018). Although studies find little evidence for biased estimates of mortality rates at older ages caused by the salmon effect in Sweden (Andersson and Drefahl 2017; Dunlavy et al. 2022), poor data quality or other data artifacts could also contribute to this result. Further investigation of this irregularity is needed. It is also difficult to assess the effect of migrant heterogeneity, as individual migrant groups are very small. However, this study lays the groundwork for further study on the effects of migrant heterogeneity on mortality and lifespan inequality estimates.

The migrant mortality advantage holds in Denmark at retirement age. Only the highest SES quartile of the Danish-born population sees a mortality advantage over migrants between the ages of 50 and 65. However, the picture is not that simple. Remaining life expectancy was higher for non-European-born men than for the highest SES quartile of the Danish-born population, and lifespan inequality at age 65 was higher for migrant men than for 3 of the 4 SES groups. We hypothesize that this is due to selection towards out-migration. When computing life expectancy the selection component is stronger, especially at older ages. Additionally, we find that the probability that an individual born in Denmark will outlive an individual born outside Denmark is around 50% for both men and women, which also indicates a high level of lifespan inequality in the migrant population. This result should caution against any policy that targets the seemingly advantageous migrant mortality gap by proposing to adjust their age at retirement relative to that of non-migrants. In Denmark, migrants do not contribute to the increase in life expectancy, as they represent a marginal proportion of the population. In Sweden, migrants negatively contribute to the increase in life expectancy, but to a much smaller degree than that observed at age 1 in Wallace et al. (2022). In short, we conclude that migrant mortality is not contributing to the changing statutory retirement ages in Denmark and Sweden and thus should not be a separate story in the evolution of pension systems.

6. Acknowledgments

JC, CS, and IK received funding from the ROCKWOOL Foundation, through the research project Challenges to Implementation of Indexation of the Pension Age in Denmark, and JC and IK received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program (Grant agreement No. 884328 – Unequal Lifespans). SD and EM received funding through the

Swedish Research Council for Health, Working Life, and Welfare (FORTE), grant number 2016-07115 and 2016-07105. JC, CS, and IK also thank Annette Baudisch, James Oeppen, Aleksandrs Aleksandrovs, the Laboratory on Longevity and Aging (LoLA), and their colleagues at the Interdisciplinary Centre on Population Dynamics (CPop) for the feedback they gave on this paper. JC is grateful for James W. Vaupel's guidance and inspiration.

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