Stockholm Research Reports in Demography | no 2021:19

Mortality advantage reversed

The causes of death driving all-cause mortality differentials between migrants, the descendants of migrants and ancestral natives in Sweden, 1997-2016

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ISSN 2002-617X | Department of Sociology

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Abstract

Although the descendants of migrants comprise growing shares of the resident populations of rich countries, we know little about their adult mortality in comparison to what we know about migrants. This is predominantly due to their smaller population sizes and younger age profiles, fundamental issues that render analysing their adult mortality difficult. Here, I take advantage of the size and scope of the Swedish register data to investigate all-cause and cause-specific mortality among three migrant-origin generations: the **G1** (migrants arriving as adults), **G15** (migrants arriving as children), and **G2** (those born in Sweden to at least one migrant parent) relative to ancestral Swedes. I use competing-risks survival analysis with an extended survival setup to study mortality among people aged 15-44 from 1997 to 2016. I ask, how does the all-cause mortality of the **G1**, **G15**, and **G2** differ from ancestral Swedes and what causes of deaths are driving these differentials? For all-causes, I find that, for most origins the lower mortality of the **G1** – relative to ancestral Swedes – contrasts with the higher mortality of the **G15** and **G2**. Exceptions are **G1** Finns and Sub-Saharan Africans who, like the **G15** and **G2**, have excess mortality. The advantages of the **G1** and the disadvantages of the **G15** and **G2** are driven by sizeable differences in external mortality, including accidents and suicides. These findings raise major concern about long-run integration and the experiences of migrant-origin populations in Sweden.

Keywords: health, mortality, causes of death, immigrants, descendants, offspring, children

Stockholm Research Reports in Demography 2021:19

ISSN 2002-617X

Introduction

Descendants of migrants represent one of the fastest growing sectors of young populations in migrant-receiving countries (Suárez-Orozco, 2018), yet we know little of their mortality in adulthood in comparison to what we know about migrants. A smaller body of work suggests that adult mortality is elevated among the descendants of migrants relative to ancestral native-born populations (De Grande et al., 2014; Guillot et al., 2019; Khlat et al., 2019; Manhica et al., 2015; Mehta et al., 2019; Singh & Siahpush, 2001; Tarnutzer et al., 2012; Vandenheede et al., 2014; Vandenheede et al., 2015; Wallace, 2016). This is alarming because this mortality *disadvantage* contrasts with the sizeable mortality *advantage*s often observed among migrants (Aldridge et al., 2018) *and* because this reversal happens within a single generation. This leads to concerns regarding the success of long-run integration processes, the amount of inequality experienced by migrant-origin populations after establishing themselves in their new country, and the future health and mortality of national populations as the share of descendants grows and ages.

To date, nearly all prior studies of mortality among migrants and descendants of migrants have lacked analyses of cause-specific mortality. While some studies have investigated one specific cause of death (e.g., suicide (Bauwelinck et al., 2017; Dunlavy et al., 2019; Hjern & Allebeck, 2002; Law et al., 2014; Thiene et al., 2015)), others *have* investigated all-cause mortality in tandem with multiple causes-of-death, but for *very* broad categories (e.g., natural and external causes (Manhica et al., 2015; Mehta et al., 2019)). This likely reflects the limitations of sample sizes and structures – an issue for all studies of the descendants of migrants, a young population that is still establishing itself in adulthood in many rich countries. Nevertheless, where feasible, a comprehensive analysis of cause-specific mortality among migrants and the descendants of migrants would represent a major contribution to the literature by (i) providing new evidence against which to test the mechanisms thought to be generating this intergenerational divergence

in mortality and (ii) providing reliable new evidence to decision makers to address ethnic health inequality.

In this paper, I capitalize on the size and scope of the Swedish registers to contribute exactly this evidence. My aims are to (1) document intergenerational all-cause mortality differentials between migrants, the descendants of migrants, and the ancestral Swedes and (2) identify the causes of death driving these differences. Using an extended, competing-risks survival setup, I investigate all-cause and cause-specific mortality between ages 15 and 44 from 1997 to 2016 for three distinct migrant-origin generations: migrants who arrived as adults (**G1**); (2) migrants who arrived as children (**G15**); (3) and (adult) children born in Sweden to *at least* one migrant parent (**G2**). The inclusion of the **G15** represents the second major contribution of this study. The **G15** represent a bridge between the **G1** and the **G2**. They experience migration – like the **G1** – but spend at least part of their formative years in the host country – like the **G2** (Mehta et al., 2019). Yet, it remains to be seen whether the mortality profile of the **G15** more accurately resembles the advantageous mortality profile of the *advantageous* **G1** or the *disadvantageous* mortality profile of the **G2**. New evidence, in either direction, would also provide significant insight into the mechanisms that are driving intergenerational differences between the **G1** and **G2**.

Background

Swedish migration history

As of 2020, there were two million migrants living in Sweden, with the main groups originating from – in descending order in terms of their population size – Syria, Iraq, Finland, Poland, Iran, Somalia, (former) Yugoslavia, Afghanistan, Bosnia and Herzegovina, and Turkey (Statistiska Centralbyrån, 2021). These groups showcase the diverse migration history of Sweden, ranging from traditional intra-Nordic migration, to post-war labour migration from Southern Europe,

refuge migration from Central & Southern America, the Middle East, Sub-Saharan Africa, and Yugoslavia toward the end of the 20th century, increasing European Union (EU) migration after the millennium, and the recent arrival of Syrians due to the migrant crisis (Migrationsverket, 2020). With migrants comprising 20% of its population, Sweden is one the largest receiving countries in Europe (Agafiţei & Ivan, 2016). For the descendants of migrants, 11% of Sweden's population has *at least* one migrant parent (Agafiţei & Ivan, 2016). This also represents one of the largest shares within Europe. With this in mind, Sweden represents an ideal context for this study.

Mortality studies of migrants in Sweden

Regarding studies of migrant mortality, a systematic review of Nordic literature found specific risk patterns among migrants in Sweden (Honkaniemi et al., 2017). Their summary of previous research found an excess mortality from all causes, certain cancers, and circulatory diseases among migrants from other Nordic countries and Central & Eastern Europe. The review also reported lower mortality from all causes, suicides, and from certain cancers among migrants from the Middle East and Southern Europe (Honkaniemi et al., 2017). The article concluded that evidence from the Nordics remained limited, especially on cause of death. They called for an expansion of the literature (Honkaniemi et al., 2017). Several articles conducted since this review have also reported similar variation in all-cause mortality by country of birth (Juárez et al., 2018; Oksuzyan et al., 2019; Rostila et al., 2021; Wallace & Wilson, 2020). The study from Juárez et al. (2018) further identified excess mortality an excess mortality among migrants who arrived before age 18 (irrespective of origin or sex), *especially* if they had lived in Sweden for 15 years or less. Such a finding is of interest here, given the inclusion of the **G15** as part of the analysis.

Mortality studies of the descendants of migrants in Sweden

There are few all-cause mortality studies among the descendants of migrants living in Sweden. One such article, which combined the **G15** and **G2** (by pooling migrants arriving as children before age six and children born in Sweden to two migrant parents and thus excluding **G2** with one migrant parent *and* child migrants arriving from age six), reported some interesting results (Manhica et al., 2015). Male descendants of migrants from Finland, former Yugoslavia, Middle East, and other non-European countries, but not Western countries or Eastern Europe, had an excess all-cause mortality compared to ancestral Swedes. This excess mortality risk was later attenuated after adjusting for education, income, and family type. Similar patterns were found (among men) in two very aggregated cause groups: natural and external causes (Manhica et al., 2015).

Another article investigated all-cause mortality and mortality from external and non-external causes the among **G15** (arriving at ages 0-19) and **G2** (using the country of birth of the mother and restricting the **G2** to those who were born within 19-years of the mother's arrival) (Mehta et al., 2019). Distinct mortality estimates were not provided for the **G15** and the **G2** and their mortality was not compared to ancestral Swedes. Rather, generational status was adjusted for in models alongside information on mother's country of birth (Finland, Rest of Scandinavia, Rest of Europe, Rest of World) in the models using observed characteristics. In sibling models generational status was adjusted for on its own. Mortality among the **G15** was higher than for the **G2**, an association evident for all-cause, non-external, and external causes (Mehta et al., 2019).

Mortality studies of migrants and the descendants of migrants in Sweden

Just one study from the literature search included estimates of all-cause mortality among both migrants and the descendants of migrants in Sweden. The article in question investigated all-

cause, cardiovascular, and cancer mortality, but only among individuals with type-2 diabetes (Bennet et al., 2020), raising some questions about the generalisability of results to the wider population. At the generational level, lower mortality was observed among the **G1** and higher mortality among the **G2** (particularly if both parents were foreign-born). In the origin-specific models, lower mortality was reported among migrants from the Middle East, Africa, Asia, and Latin America, and – in the SES-adjusted model – among migrants from EU28 and Europe. Nordic migrants had excess mortality. Among the descendants of migrants – for which broader origins were defined – mortality was elevated among descendants of Nordic, other European, and North American migrants, but it was not significantly different from the ancestral Swedes. Cardiovascular mortality was generally lower among non-Western migrants, but not among the descendants of non-Western migrants. Little was found for cancer mortality (Bennet et al., 2020).

Regarding specific causes of death, a spate of studies from the early 2000s focused upon cancer mortality among the **G1** and **G2** in Sweden. They showed that large differences found among migrants for a wide range of cancer sites almost completely disappeared among the descendants of migrants (Hemminki & Li, 2002a; Hemminki et al., 2002b; Hemminki & Li, 2002c). They also found significant protective effects among migrants for some cancers sites were detectable among the descendants of migrants. These findings match the international literature (Balzi et al., 1995; Hemelrijck et al., 2017; Parkin & Iscovich, 1997; Parkin & Khlat, 1996; Thomas & Karagas, 1987). Several papers on suicide mortality have been conducted (Dunlavy et al., 2018; Hjern & Allebeck, 2002; Thiene et al., 2015), where the **G2** have higher suicide mortality than the **G1** with a rate closer to ancestral Swedes. Variation is seen in the high suicide mortality of **G1** and **G2** Finns and Western Europeans and low suicide mortality of **G1** Southern Europeans and Middle Easterns (Hjern & Allebeck, 2002). Labour market marginalisation (Thiene et al., 2015) and unemployment status (Dunlavy et al., 2018) play a key role in the patterns. Dunlavy

et al. (2018) also found an increased suicide risk among migrants with a younger age at arrival. The findings adhere to wider studies (Bauwelinck et al., 2017). A study investigating coronary heart disease mortality in the **G1** and **G2** showed an increased risk to persist across generations for Finns, Central & Eastern Europeans, and Turks), notably for men (Sundquist & Li, 2006). Hjern & Allebeck (2004) investigated the risk for hospital admission due to alcohol disorders for the **G1** and **G2**. They reported high relative risks among **G1** and **G2** Finns (versus ancestral Swedes), low relative risks (versus ancestral Swedes) among **G1** Southern Europeans and Middle Easterns, and an intermediate risk for the **G2**. In a study of alcohol-related mortality, people with mixed Finnish/Swedish background had an intermediate risk of mortality that fell between those with Finnish or Swedish background in these two countries (Saarela & Kolk, 2020).

International mortality studies of migrants and the descendants of migrants

In Anglo-Saxon countries, several studies have been conducted. In England and Wales, a study found that mortality among native-born Black Caribbeans and Pakistanis & Bangladeshis was elevated relative to the White UK-born. It remained elevated after adjusting for socioeconomic position, but only significantly so among the **G2** Black Caribbeans. Mortality among the two respective foreign-born groups was depressed relative to the White UK-born (Wallace, 2016). These findings matched a previous UK study (Scott & Timæus, 2013). In the United States, a similar native and foreign-born ethnic minority differentiation has been used in studies. A 2001 study found that migrants from the groups Hispanics, Blacks, Asian and Pacific Islanders and non-Hispanic whites all had lower mortality than their native-born counterparts. Yet, only US-born Blacks had higher mortality than the White US-born (Singh & Siahpush, 2001). Similar patterns were reported several years later in the higher life expectancy of foreign-born Blacks and Hispanics as compared to US-born Hispanics and Blacks. However, life expectancy was higher for the native-born in some groups, including Chinese, Japanese, and Filipino (Singh &

Miller, 2004). Other studies have focused on Hispanics, reporting low mortality among foreign-born – but not US-born – Hispanics for a wide range of causes of death (Eschbach et al., 2007), additional mortality variation according to specific origins (Fenelon et al., 2017), and a lack of mortality advantage for foreign-born Hispanics arriving as children (ages 0-17) (Holmes et al., 2015).

Several studies have been conducted in European francophone countries. In France, one study observed a mortality advantage among **G1** Northern Africans and Southern Europeans. Among the **G2**, however, divergent patterns were documented. A mortality advantage persisted among **G2** Southern Europeans but **G2** Northern Africans had a mortality disadvantage that persisted after adjusting education level (Guillot et al., 2019). A subsequent study found this **G2** excess among Northern Africa men to be driven by economic inactivity and unemployment (Khlat et al., 2019). In Switzerland, a study documented a mortality advantage among **G1** Italian men and women over the majority Swedish population, but a loss of advantage among **G2** women and a reversal of it among **G2** men (Tarnutzer et al., 2012). In Belgium, a study of mortality across generations and multiple origins observed large mortality advantages among **G1** Italian, French, Dutch, Moroccan, Turkish, and Sub-Saharan African migrants – especially if they had recently arrived in Sweden. The study found a disadvantage among most of these **G2** groups, particularly those of non-Western origin (Vandenheede et al., 2015). Unlike for the **G1**, cancer, cardiovascular and infectious diseases mortality tended to be elevated among non-Western **G2** (Vandenheede et al., 2015). Similar patterns were observed in a study of **G1** and **G2** Turks and Moroccans (Vandenheede et al., 2014). Another study found a mortality gradient in **G1**, **G15**, and **G2** Moroccan/Turkish and Sub-Saharan African men. Mortality was lower for **G1**, intermediate for **G15** – but lower than Belgian-born – and higher for **G2** (De Grande et al., 2014).

Mechanisms

In-selection effects

The mortality advantage among migrants is often argued to be explained by in-selection effects. That is to say, that people who move between countries are selected *directly* upon their good health and *indirectly* upon factors associated with good health (Guillot et al., 2018a). Selection effects are thought to be strongest just after migrants arrive in the receiving country and wear off over time (Wallace & Wilson, 2019). Among migrants arriving as children, selection effects are proposed to be much weaker – or non-existent – because they do not self-select (like adult migrants) but are selected by their parents and play no active role in the migration process (Guillot et al., 2018a). Among the **G2**, selection plays no role in determining their mortality risk, unless heritable genetics plays some role in the lower mortality of the **G1** (Spallek et al., 2011).

Out-selection effects

One theory, the "salmon bias effect" (Pablos-Méndez, 1994), proposes that migrants in poor health are more likely to return to their birth country. Consequently, only more robust migrants who remain the host country are included in calculations of mortality and the estimate is not truly reflective of all of the migrants who originally moved to the host country (Guillot et al., 2018a). If this process is taking place on a large-scale, it could conceivably generate mortality differences between migrants and the descendants of migrants, who are not subjected to any such out-selection and whose mortality may well more accurately reflect that of migrant-origin populations.

Cultural factors

Another theory posits that some migrant groups exhibit healthier behaviours than the ancestral population of the host country due to the prevailing influence of healthier cultural norms in the

country of origin (Guillot et al., 2018a). Under this explanation these behaviours, which may include low smoking prevalence, low alcohol consumption, and a very nutritious diet, combine to generate a lower overall mortality risk among migrants. This "cultural buffer" is believed to be strongest just after migrants arrive and erodes over time given adaptation to the host society (Wallace & Wilson, 2019). It seems likely that the greater level of exposure of descendants, combined with the ages at which they are exposed to the host society, would affect their health behaviours. Furthermore, some argue that the adaptation level of the parents can be crucial for intergenerational transitions in behaviour (towards those of the host country society) (Spallek et al., 2011). It may be that descendants of migrants lack the protective "cultural buffer" of the **G1**. They may also, like the **G1**, be affected by gene-environment interactions that amplify the adverse effects of certain behaviours, more so than for the ancestral population (Spallek et al., 2011).

Social conditions

While migrants spend their formative years growing up in their country of origin, descendants of migrants spend at least some (the **G15**) or all (the **G2**) of it in the host country. There may be factors linked to this crucial period of development that affect the adult mortality risk of the descendants of migrants (Spallek et al., 2011), such as the social conditions they are subjected to. It could be that while migrants spend their early years in a position of relative *advantage* in the origin society, descendants spend their early years in a position of relative *disadvantage* in the host society. A socioeconomic paradox, in which migrants display a mortality advantage over the ancestral population *despite* the unfavourable social conditions they experience in the receiving country has been pervasively documented (Khlat & Darmon, 2003; Ruiz et al., 2013). Previous research has found, at least among general populations, a strong association between socioeconomic position in childhood and elevated early adult mortality risk (Galobardes et al., 2004).

Psychosocial factors

Previous research has often alluded to the idea that migrants possess certain personality traits, such as being more highly motivated, decisive, and risk-averse than non-migrants (Boneva & Frieze, 2001; Chiswick et al., 2008). Such traits, it is argued, are factors that may help migrants cope with the physical, psychological and sociological challenges of immigration (Gushulak, 2007). It could be that the descendants of migrants lack these traits and are less able to cope with similar challenges. One such challenge might be experiences of racism and discrimination. The descendants of migrants may represent an age-specific vulnerability to such experiences that might go on to manifest itself in adult mortality risk, particularly from external causes such as suicide (Hjern & Allebeck, 2002). We might also consider how growing up in the receiving country might change the frame of reference between migrants and descendants of migrants – from other migrant groups or non-migrant population of the origin country to the non-migrant population of the host country (Wallace, 2016). Such a shift may be important in terms of self-perception of one's health, social position, and the level of (in)equality that they experience. Variation in such perceptions can affect both health status and health behaviours (Lynch et al., 2000).

Data artefacts

Data-related problem centre on the idea that migrant mortality is not genuinely low. Instead, a mortality advantage is generated by an inability to capture the emigrations of migrants in data sources and identify people who have emigrated (Wallace & Wilson, 2019). Consequently, studies continue to include emigrants in calculations of mortality of mortality even though they cannot "die" in the host country. This leads to mortality estimates that are substantially lower than the actual mortality level of migrants might be (Kibele et al., 2008). If the descendants of migrants are not subjected to such errors, and the downward bias induced in migrant mortality

rates is large, this could conspire to generate intergenerational mortality differences between them.

Research questions

Based upon the extant literature, I propose five questions for migrants and the descendants of migrants:

RQ1)	How does *all-cause* mortality vary relative to the ancestral Swedes?
RQ2)	What are the leading causes of death in each subgroup?
RQ3)	How does *cause-specific* mortality vary relative to the ancestral Swedes?
RQ4)	What causes of death are driving the all-cause mortality differentials?
RQ5)	All the above considered, is the mortality of the **G15** closer to the **G1** or **G2**?

Data and methods

The Swedish registers

This study uses the collections of Swedish register data "*Ageing Well*" organised at Stockholm University. This data is accessible for research under ethical approval from the regional ethics board in Stockholm. It comprises longitudinal individual-level data from several administrative datasets. Available data covers the total population of Sweden annually from 1961 until 2020. I focus on the period 1997-2016 due to the small number of adult descendants of migrants (and deaths) prior to 1997 and lack of information on cause of death after the end of 2016. I merge information from four registers: (1) the total population register, which acts as the official base register for the production of statistics on Sweden's population; (2) the migration register, which contains data on moves into and out of Sweden; (3) the death register, which is of high quality, covering all deaths in Sweden and resident deaths abroad; and (4) the multigenerational

register, which contains traces that can link children to parents (permitting identification of the **G2**).

Defining migrants and the descendants of migrants

The first-generation (the **G1**) are defined as individuals who are foreign-born who arrived in Sweden on or after age 15. The one-point-five-generation (the **G15**) are defined as individuals who are foreign-born who arrived in Sweden at ages 0 to 14. The second-generation (the **G2**) are defined as individuals who were born in Sweden who have *at least* one foreign-born parent. Ancestral Swedes are defined as individuals born in Sweden to two parents born in Sweden. Mortality hazard ratios are estimated at three levels of detail for migrants and their descendants, (1) at the generational level (ancestral Swedes, **G1**, **G15**, **G2**), (2) according to whether they have western or non-western origins (ancestral Swedes, **G1** Western, **G1** non-Western, **G15** Western, **G15** non-Western, **G2** Western, and **G2** non-Western), and (3) according to specific individual and parental birth regions (Finland, other Nordic, other Western countries, Central & Eastern Europe, the Middle East, Central & Southern America, Sub-Saharan Africa, and Asia).

Mortality

An indicator of all-cause mortality is derived from the death register using exact date of death. Causes of death is organised (*ICD-10*) into cancers (**C00-D49**), circulatory diseases (**I00-I99**), other diseases & medical conditions (**A00-B99**; **D50-H99**; **J00-Q99**), accidents (**V00-V99**; **W00-W99**; **X00-X59**), suicides (**X60-X84**; **Y87**), other external causes (**X85-X99**; **Y00-Y99**), and ill-defined causes (**R00-R99**). I study mortality between ages 15 and 44, rather some open-ended interval, because the age structures and the age-at-death distributions of the **G15** and **G2** (notably those with non-Western origins) are still very young, as Figure S1 and Figure S2 both show.

Survival setup and analysis

To examine the mortality levels of migrants and descendants of migrants relative to ancestral Swedes, I estimate all-cause and cause-specific mortality hazard ratios (HRs) using competing-risks survival analysis. Entry into the risk set can begin in several ways. People resident in Sweden aged between 15 and 44 on January 1st 1997 become "at risk" from this date. People resident in Sweden on January 1st 1997 who are younger than age 15 become "at risk upon" reaching age 15, as long as that occurs before 31st December 2016 and the person is still resident in Sweden. People who are not resident in Sweden on January 1st 1997 but assume residency on a later date – as long as that date is before December 31st 2016 – become "at risk" from their date of arrival in Sweden if aged 15 and 44. Finally, people arriving in Sweden between 1st January 1997 and 31st December 2016 who are younger than age 15 on their date of arrival will become "at risk" upon reaching age 15, as long as that occurs before 31st December 2016. Residency is verified at the end of each calendar year in the registers, with a variable indicating the county of residence. For all individuals, exit from the risk set takes place when (a) people die, (b) emigrate (where emigrations are registered), (c) are no longer classed as resident in the population register (where emigrations are not registered), (d) reach age 45 alive and before December 31st 2016, or (e) reach December 31st 2016 alive, in Sweden, and younger than age 45.

I implement an extended survival setup whereby, if there are *K* competing events (in this case seven causes of death), each person requires *K* rows in a long-form data file – one representing each possible cause of failure. A column variable "cause" is used to denote the event type or failure cause to which each cause refers. The value of the time variables remain identical over the *K* rows of each person, but the event variable changes. Instead of values *0, 1,..., K*, the event variable takes on the value 1 if the corresponding event type (i.e., the cause of death) is the one that occurred (and 0 if otherwise). The values of covariates are simply replicated for individuals

over the *K* rows. Such a dataset is created by producing seven datasets – one for each cause of death – as if one were modelling each cause of death separately, and then appending all of the datasets.

I then fit Cox Proportional Hazards models, with age specified as the timescale in the regression models. With the setup as described above, the assumption is made that baseline cause-specific hazards are proportional. Even though this assumption often proves to be unrealistic, this kind of proportional risk model boasts the nice property that the probability of a person failing due to cause k follows a logistic model (Putter et al., 2007). Robust estimates of standard errors are estimated to correct for the correlation that is caused by multiplication of the data set (even if standard estimates suffice, with each person experiencing just one event). For more information on this setup and benefits of this approach, one could refer to the methods article (Putter et al., 2007).

Modelling Strategy

Models 1a-c adjust for birth cohort, cause of death (with cancer as the reference), and one of (a) generation (ancestral Swedes, **G1**, **G15** and **G2**), (b) generation by western and non-western origin, or (c) generation by ego and parental origin regions. Ancestral Swedes always act as the reference. The purpose of the model is to reveal all-cause mortality differences between ancestral Swedes, migrants, and the descendants of migrants at increasing levels of detail. By specifying cause of death as a covariate, we can see how the hazard ratio of mortality from the given causes varies among the total population aged 15-44 between 1997 and 2016. Hazard ratios from these models, in Figure 1, help answer research question 1. The model is expressed as:

$$ln\mu(t) = ln\mu_0(t) + \propto k + \gamma Z + \beta x$$

Whereby $\boldsymbol{\mu(t)}$ represents the hazard of mortality at age $\boldsymbol{t}$, $\boldsymbol{\mu_0(t)}$ represents the baseline hazard, $\propto$ denotes the effect of the $\boldsymbol{k}^{\text{th}}$ cause of death ($\boldsymbol{k}$ = 1…7) on all-cause mortality, $\boldsymbol{\gamma}$ denotes the effect of migrant-origin population variable $\boldsymbol{Z}$, and $\boldsymbol{\beta}$ denotes the effect of birth cohort variable $\boldsymbol{x}$.

Models 2a-c elaborates upon this model by adjusting for birth cohort and, instead, combinations of causes of death by (a) generation, (b) generation by western and non-western origins), and (c) generation by specific ego and parental origin regions. Cancer mortality among the ancestral Swedes always acts as the reference group. Specifying such a model provides the added benefit of estimating everything to one common reference point. This then gives an indication as to how mortality from a given cause varies both *within* and *across* population subgroups. Hazard ratios from these models, shown in Tables 2-4 and Figure 2, help answer research questions 2-3.

$$ln\mu(t) = ln\mu_0(t) + y_k Z + \beta x$$

Whereby the migrant status variable **Z** is now permitted to vary according to specific causes of death.

From a potentially eligible starting sample of 6,666,295 people, 99.07% of the total population of Sweden aged 15-44 between 1997 and 2016 was retained. 41,180 (0.62%) of people were dropped due to lack of information on country of birth, 8,363 while 20,576 (0.32%) of people were dropped due to problems with event dates in the survival setup (e.g., negative duration). This left a final analytical sample of 6,604,539 people and 43,515 deaths. Confidence intervals are provided, as a measure of population variance, but great stock is placed in the actual hazard ratios.

Table 1. Risk-time and deaths by sex, generation, and lowest level origins in Sweden, 1997-2016, people aged 15-44.

Sex by ego/parental birth region	Generation 1				Generation 15				Generation 2			
	Risk-time	%	Deaths	%	Risk-time	%	Deaths	%	Risk-time	%	Deaths	%
Men												
Ancestral Swedes	25,803,917		20,270									
All regions	3,848,840	*100*	2,551	*100*	1,936,640	*100*	1,906	*100*	4,455,118	*100*	4,381	*100*
Western-origin	1,666,081	*43*	1,316	*52*	900,384	*46*	1,024	*54*	3,638,648	*82*	3,837	*88*
Finland	114,661	*3*	275	*11*	209,832	*11*	459	*24*	1,574,949	*35*	1,985	*45*
Other Nordic	185,336	*5*	141	*6*	99,162	*5*	92	*5*	576,032	*13*	585	*13*
Central & Eastern Europe	878,904	*23*	663	*26*	443,012	*23*	341	*18*	703,912	*16*	584	*13*
Other Western countries	487,179	*13*	237	*9*	148,378	*8*	132	*7*	783,755	*18*	683	*16*
Non-Western origin	2,182,759	*57*	1,235	*48*	1,036,256	*54*	882	*46*	816,469	*18*	544	*12*
The Middle East	1,182,397	*31*	674	*26*	446,779	*23*	347	*18*	424,566	*10*	278	*6*
Central Southern America	183,812	*5*	111	*4*	208,563	*11*	185	*10*	149,306	*3*	106	*2*
Sub-Saharan Africa	394,728	*10*	309	*12*	121,011	*6*	130	*7*	86,341	*2*	72	*2*
Asia	421,823	*11*	141	*6*	259,903	*13*	220	*12*	156,256	*4*	88	*2*
Women												
Ancestral Swedes	24,354,471		10,036									
All regions	4,006,459	*100*	1,584	*100*	1,870,247	*100*	800	*100*	4,201,209	*100*	1,987	*100*
Western-origin	1,776,440	*44*	774	*49*	841,834	*45*	431	*54*	3,435,301	*82*	1,759	*89*
Finland	190,401	*5*	167	*11*	205,627	*11*	183	*23*	1,496,526	*36*	844	*42*
Other Nordic	168,081	*4*	75	*5*	94,883	*5*	58	*7*	539,493	*13*	305	*15*
Central & Eastern Europe	1,085,130	*27*	440	*28*	406,834	*22*	135	*17*	663,893	*16*	294	*15*
Other Western countries	332,828	*8*	92	*6*	134,490	*7*	55	*7*	735,390	*18*	316	*16*
Non-Western origin	2,230,019	*56*	810	*51*	1,028,413	*55*	369	*46*	765,907	*18*	228	*11*
The Middle East	1,007,541	*25*	300	*19*	390,540	*21*	107	*13*	398,331	*9*	114	*6*
Central Southern America	205,217	*5*	75	*5*	183,592	*10*	64	*8*	139,323	*3*	35	*2*
Sub-Saharan Africa	390,656	*10*	206	*13*	110,287	*6*	54	*7*	83,705	*2*	28	*1*
Asia	626,605	*16*	229	*14*	343,995	*18*	144	*18*	144,548	*3*	51	*3*

Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Results

Table 1 shows the frequency and percentage of risk-time and deaths by origins across the three generations. At the generational level, the **G2** contribute the most risk-time of all generations, followed closely by the **G1**. The **G15** are some way behind, a pattern also reflected in the number of death events. When the generations are divided into Western and non-Western origins, the origin composition of the **G1** and the **G15** falls narrowly in favour of non-Western origins. Despite this, the percentage contribution of risk-time for non-Western-origin **G1** and **G15** always remains higher than the percentage contribution of deaths; the opposite is then true for Western-origin **G1** and **G15**. At the most granular level, **G1** and **G15** migrants from Central & Eastern Europe represent the largest Western-origin group, while the Middle East represent the largest non-Western-origin group. The **G2**, conversely, are overwhelmingly of Western- (and Finnish) origin. Few **G2** have non-Western origins. Indeed, **G2** with Central & Southern America, Sub-Saharan African, and Asian origins combined provide less risk-time to the **G2** than the Middle East, a group that itself only contributes a small amount of risk-time for the **G2**.

Figure 1 presents hazard ratios of all-cause mortality among male and female migrants and the descendants of migrants in Sweden aged 15-44 between 1997 and 2016. The estimates (from Models 1a-c) are adjusted for age and birth cohort and are relative to the mortality of ancestral Swedes. The full regression tables can be found in Table S1 (1a), Table S2 (1b), and Table S3 (1c). At the generational level, while mortality is lower among **G1** men (HR=0.76 [0.73-0.79]) and **G1** women (HR=0.84 [0.80-0.89]), mortality is elevated in every generation of the descendants of migrants, ranging from HR=1.25 [1.19-1.31] among **G2** women to HR=1.45 [1.38-1.52] among **G15** men. When the generational groups are categorised into migrants and the descendants of migrants of Western and non-Western-origins, similar patterns and indeed

hazard ratios of a similar magnitude are observed as those reported at the broadest generational level.

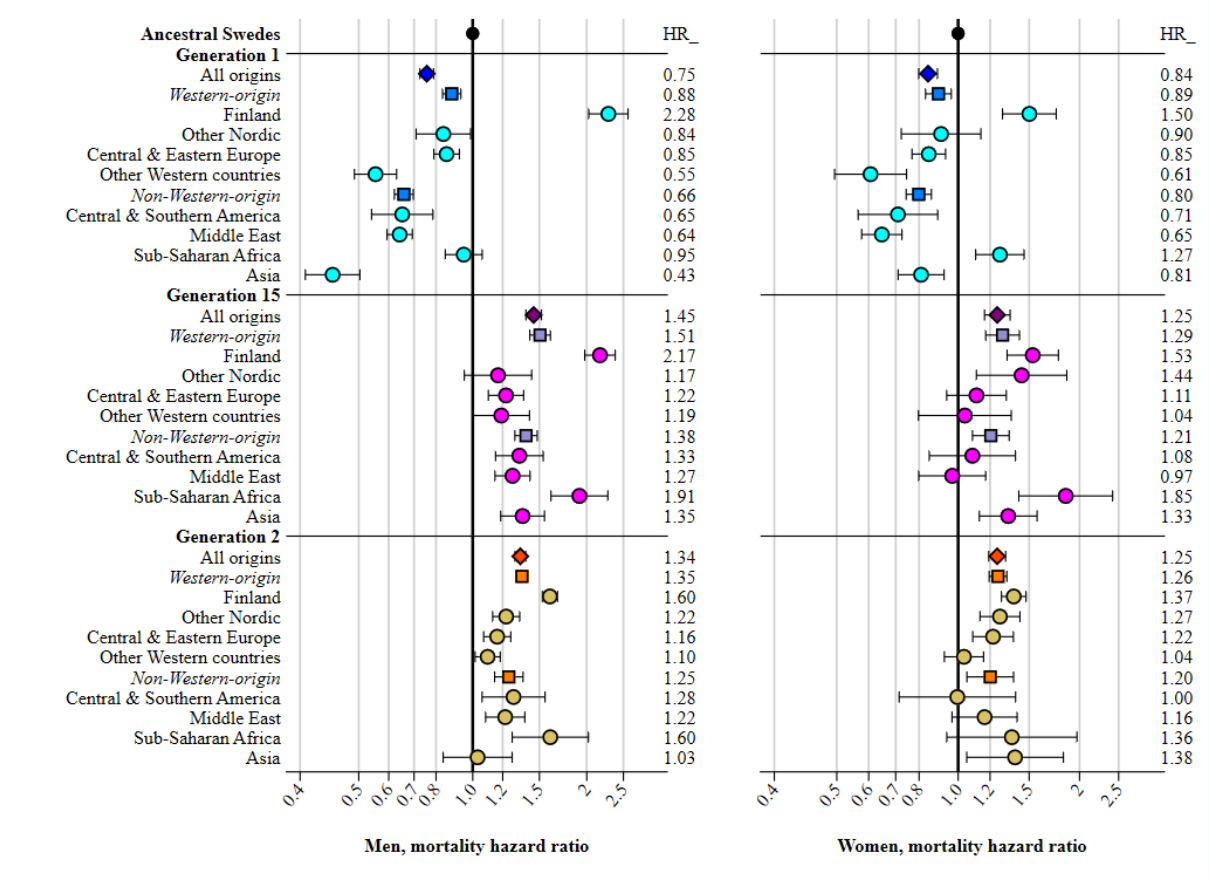

Figure 1. Age and birth cohort adjusted hazard ratios of all-cause mortality by sex, generation and lower level origins in Sweden, 1997-2016, ages 15-44.
Notes: full regression models available in Table S1 (Model 1a), Table S2 (Model 1b), and Table S3 (Model 1c)
Source: author's calculation based upon the Swedish register data collection "Ageing Well"

At the most detailed level, we begin to see some variation in the direction and size of the hazard ratios. Among **G1** with Western-origins, Finnish migrants stand out as having a large excess mortality when all other groups experience a mortality advantage (male HR=2.28 [2.03-2.57]; female HR=1.50 [1.29-1.75]). Migrants from other Western countries, on the other hand, have the largest advantage of all the Western-origin **G1** groups (male HR=0.55 [0.49-0.63]; female HR=0.61 [0.49-0.74]). Among **G1** with non-Western origins, women from Sub-Saharan Africa stand out for their sizable mortality excess (HR=1.27 [1.11-1.46]); men have a negligible advantage (HR=0.95 [0.85-1.06]). Otherwise, all other non-Western origin **G1** groups (Central

& Southern America, the Middle East, and Asia) boast large advantages over ancestral Swedes, from HR=0.81 [0.71-0.92] among women from Asia to HR=0.43 [0.46-0.50] among men from Asia.

Among the descendants of migrants (i.e., **G15** and **G2**), the picture is very different. Mortality is elevated in nearly all origins and no single group has a mortality advantage over the ancestral Swedish population. Among the **G15**, mortality is especially elevated among men who arrived as children from Finland (HR=2.17 [1.98-2.38]) and men and women who arrived as children from Sub-Saharan Africa (male HR=1.91 [1.61-2.27]; female HR=1.85 [1.41-2.42]). Among the **G2**, men with Finnish (HR=1.60 [1.53-1.67]) and Sub-Saharan African origins all face a substantial elevated mortality risk (HR=2.17 [1.98-2.38]). These kind of excesses are perhaps less surprising in the context of the excess mortality risks that tend to be faced by their **G1** groups.

More prominent are the lack of advantages and excess risks faced by those **G15** and **G2** groups in the context of the large mortality advantages reported for the **G1**. For example, the mortality excesses among male descendants with Middle Eastern origins (**G15** HR=1.27 [1.15-1.42]; **G2** HR=1.22 [1.08-1.37]) compared to the low relative mortality of **G1** men from the Middle East (HR=0.64 [0.59-0.69]). The same observation can be made for all other male groups (i.e., a full reversal in mortality risk from advantage to disadvantage between the migrant and descendant generations), with the exception of **G2** men with Asian origins who are neither advantaged nor disadvantaged (HR=1.03 [0.84-1.27]). The same pattern broadly holds among women, albeit there are more instances of the **G15** and **G2** groups not being advantaged rather than being dis-advantaged.

Table 2 shows the number of deaths from cancer, circulatory diseases, other diseases & medical conditions, accidents, suicides, other external causes of death, and ill-defined causes of death,

Table 2. Deaths by cause, sex, generation, and ego/parental birth region in Sweden, 1997-2016, people aged 15-44.

	Cancer		Circulatory		Other dis.		Accidents		Suicides		Other Ext.		Ill-defined		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Men																
Ancestral Swedes	2,907	14	2,292	11	3,326	16	5,249	26	4,357	21	1,597	8	542	3	20,270	100
Generation 1	475	19	367	14	392	15	430	17	397	16	229	9	261	10	2,551	100
Western	224	17	193	15	208	16	224	17	222	17	96	7	149	11	1,316	100
Non-Western	251	20	174	14	184	15	206	17	175	14	133	11	112	9	1,235	100
Generation 15	201	11	161	8	286	15	508	27	389	20	273	14	88	5	1,906	100
Western	116	11	109	11	179	17	266	26	190	19	113	11	51	5	1,024	100
Non-Western	85	10	52	6	107	12	242	27	199	23	160	18	37	4	882	100
Generation 2	426	10	394	9	707	16	1,177	27	987	23	513	12	177	4	4,381	100
Western	389	10	365	10	636	17	1,019	27	871	23	416	11	141	4	3,837	100
Non-Western	37	7	29	5	71	13	158	29	116	21	97	18	36	7	544	100
Total	4,009	14	3,214	11	4,711	16	7,364	25	6,130	21	2,612	9	1,068	4	29,108	100
Women																
Ancestral Swedes	3,543	35	929	9	1,862	19	1,259	13	1,677	17	546	5	220	2	10,036	100
Generation 1	666	42	139	9	248	16	103	7	187	12	125	8	116	7	1,584	100
Western	320	41	70	9	102	13	54	7	110	14	59	8	59	8	774	100
Non-Western	346	43	69	9	146	18	49	6	77	10	66	8	57	7	810	100
Generation 15	228	29	55	7	143	18	99	12	188	24	57	7	30	4	800	100
Western	140	32	38	9	79	18	49	11	87	20	25	6	13	3	431	100
Non-Western	88	24	17	5	64	17	50	14	101	27	32	9	17	5	369	100
Generation 2	550	28	148	7	353	18	290	15	428	22	139	7	79	4	1,987	100
Western	503	29	136	8	308	18	245	14	375	21	127	7	65	4	1,759	100
Non-Western	47	21	12	5	45	20	45	20	53	23	12	5	14	6	228	100
Total	4,987	35	1,271	9	2,606	18	1,751	12	2,480	17	867	6	445	3	14,407	100

Notes: frequencies for lowest level origins available in Table S4 (men) and Table S5 (women)

Source: author's calculation based upon the Swedish register data collection "Ageing Well"

and represents a shift in the analysis to mortality from specific causes of death. The number of deaths is presented alongside the percentage of total deaths that each causes comprises at the generational level and for Western-origin and non-Western-origin groups of men and women. The frequency of deaths by lowest level origins can be found in Table S4 (men) and Table S5 (women).

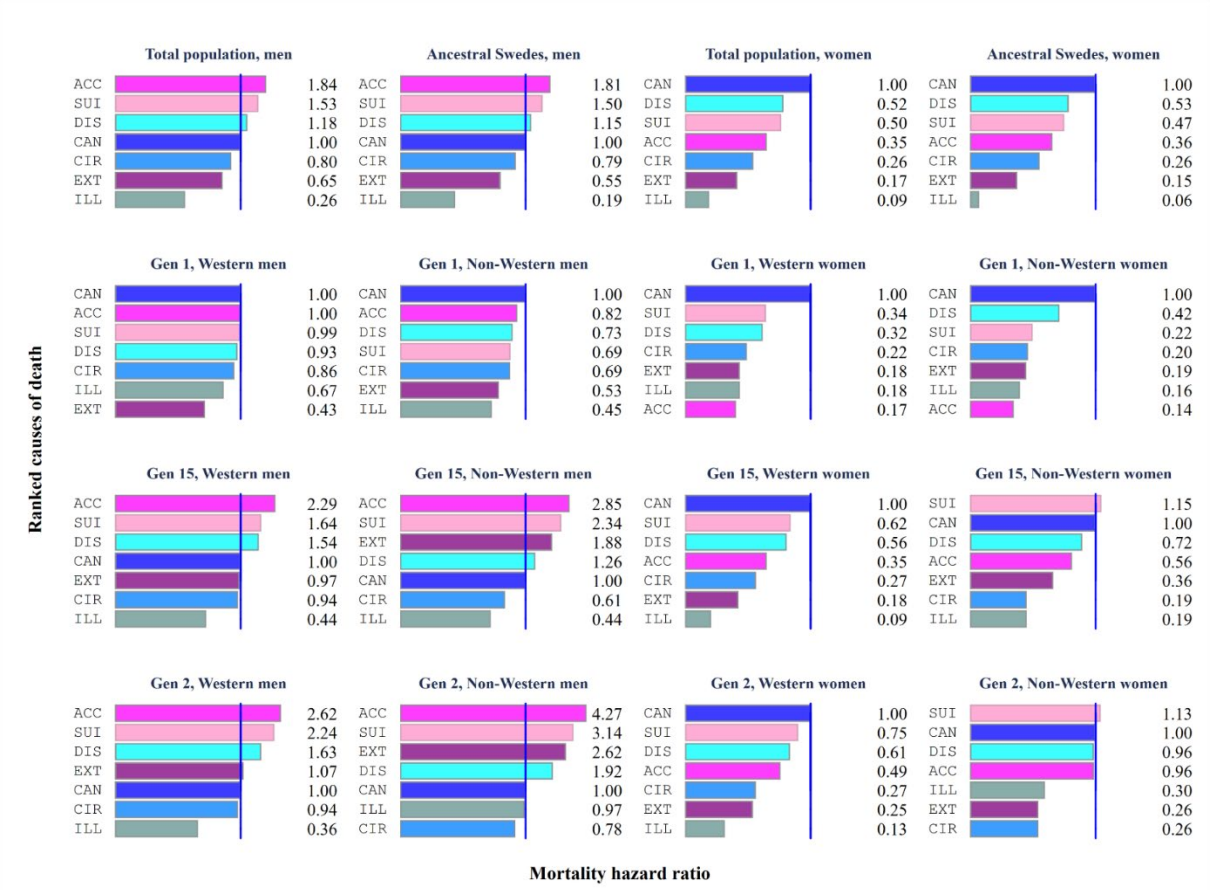

Figure 2. Age and birth cohort adjusted hazard ratios of cause-specific mortality by sex, *within* generation by western non-western origin groups in Sweden, 1997-2016, ages 15-44.
Notes: original extended regression models available in Tables S8-S12; formatted hazard ratios for lowest level origins available in Table S6 (Men) and Table S7 (women)
Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Figure 2 presents results from Models 2a-c, with – for ease of interpretation – the hazard ratios re-estimated to show how mortality from circulatory diseases (CIR), other diseases & medical conditions (DIS), accidents (ACC), suicides (SUI), other external causes (EXT), and ill-defined causes (ILL) varies relative to cancer *within* the ancestral Swedes and Western, non-Western

categories of migrants and descendants of migrants. Within each subpanel – which represents a distinct subgroup – causes are ranked from top (i.e., leading cause of death) to bottom. From this panel, we can see which causes of death are most important, combined with the weight that they carry in the total mortality of each subgroup. Formatted estimates for lowest level origins are in Table S6 and Table S7. The original extended regression models are available in Table S8 (2a), Table S9 (2b, men), Table S10 (2b, women), Table S11 (2c, men), and Table S12 (2c, women).

For ancestral Swedish men aged 15-44 between 1997 and 2016, accidents are the leading cause of death, followed by suicides, other diseases & medical conditions, cancer (i.e., the reference), circulatory diseases, other external causes, and ill-defined causes. For **G15** and **G2** Western-origin men, the ranking of the causes is broadly comparable to ancestral Swedish men, albeit mortality from other external causes is more prominent. For **G15** and **G2** non-Western-origin men, the top three causes of death are all external (accidents, suicides, and then other external). Additionally, for all of the male descendant groups – and particularly those of non-Western origin – we see a larger magnitude of mortality in the external cause groups relative to cancer. For **G1** Western-origin and non-Western origin men, in contrast, mortality from an external cause category is *not* the leading cause of death. For **G1** Western-origin men, cancer, accidents, suicides, and other diseases & medical condition mortality all carry a similar weight. For **G1** non-Western-origin men, cancer is the undisputed leading cause of death. This is a fascinating finding given what we know about mortality accident humps and causes of death among young men.

For ancestral Swedish women aged 15-44 between 1997 and 2016, mortality from cancer is the leading cause of death, followed by mortality from other diseases & medical conditions, suicides, accidents, circulatory diseases, other external causes, and ill-defined causes. Cancer mortality is also the leading cause of death in four of the six female descendant groups: **G1**

Western-origin and non-Western-origin and **G15** and **G2** Western-origin women. For **G15** and **G2** non-Western-origin women, in contrast mortality from suicide is the leading cause of death. Furthermore, among **G2** Western-origin women, mortality from other diseases & medical conditions is *as* important as mortality from cancer. We can also highlight the small hazard ratios of all of the other cause of death categories compared to cancer mortality among the **G1** groups.

Table 3 (men) and Table 4 (women) show results from Models 2a-c, with the hazard ratios this time re-estimated to show how mortality from specific causes among migrants and descendants of migrants varies relative to the same cause in ancestral Swedes. Generation and combinations of generation by origin form the rows; cause of death form the columns. The cause of death columns are ordered so that natural causes (cancers, circulatory diseases, and other diseases & medical conditions) represent the left-hand side of the table, while external cause (accidents, suicides, and other external causes) represent the right-hand side. To facilitate interpretation, each table is divided into generational subtables. They further take the form of a heat map. Blue and lighter shades thereof, indicate low (and increasingly lower) mortality from a specific cause of death. Purple and increasingly darker shades thereof, indicate high (and increasingly higher) mortality. All-cause hazard ratios are provided for reference. Significant results are shown with bold.

First, I address mortality from ill-defined causes. Mortality from ill-defined causes is almost systematically elevated among the **G1**, **G15**, and **G2** relative to ancestral Swedes. This column stands out sharply for the **G1**, given that it contrasts so starkly with lower mortality from the other causes. R codes are ascribed to deaths when no diagnosis is classifiable elsewhere. Many of these cases are also "R99" codes in which no information can be given regarding cause of death (Brooke et al., 2017). Certainly, among the **G1** and **G15** – and perhaps the **G2** – this may relate to a death abroad, given such cases are captured in the Swedish cause of death register.

Table 3. Age and birth cohort adjusted hazard ratios of cause-specific mortality *across* generation, western non-western origins, and lowest level origins in Sweden, 1997-2016, men aged 15-44.

Males	*Cancer*	*Circulatory*	*Other diseases*	*Accidents*	*Suicides*	*Other external*	*Ill-defined*	*All-causes*
Ancestral Swedes (REF)	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Generation 1								
All	0.98	0.96	**0.71**	**0.49**	**0.55**	**0.86**	**2.89**	**0.76**
Western-origin	1.04	**1.14**	**0.85**	**0.58**	**0.69**	**0.81**	3.73	**0.88**
Finland	**1.50**	**3.82**	**3.34**	**1.54**	**1.74**	1.47	**7.45**	**2.28**
Other Nordic	0.83	0.84	0.72	**0.60**	0.91	0.60	**3.99**	**0.84**
Other Western	0.77	**0.56**	**0.53**	**0.37**	**0.51**	**0.33**	**2.36**	**0.55**
Central & Eastern Europe	**1.18**	**1.12**	**0.67**	**0.54**	**0.58**	1.03	**3.85**	**0.85**
Non-Western-origin	0.93	**0.82**	**0.60**	**0.42**	**0.43**	0.90	**2.23**	**0.66**
Middle East	0.98	0.89	**0.48**	**0.44**	**0.39**	0.93	**1.96**	**0.64**
Central Southern America	0.82	**0.57**	**0.64**	**0.34**	0.74	0.74	**2.20**	**0.65**
Sub-Saharan Africa	**1.13**	1.03	**1.18**	**0.53**	**0.63**	**1.24**	**3.90**	0.95
Asia	**0.65**	**0.51**	**0.37**	**0.32**	**0.24**	**0.54**	**1.47**	**0.43**
Generation 15								
All	1.07	1.08	**1.32**	**1.49**	**1.38**	**2.63**	**2.50**	**1.45**
Western-origin	**1.19**	**1.42**	**1.60**	**1.51**	**1.30**	**2.11**	**2.81**	**1.51**
Finland	**1.75**	**2.38**	**2.59**	**1.90**	**1.98**	**3.18**	**2.12**	**2.17**
Other Nordic	**0.35**	**1.46**	**1.54**	**1.37**	1.00	0.80	**2.37**	**1.17**
Other Western	**1.38**	**1.36**	**1.10**	0.87	1.01	**1.72**	**3.03**	**1.19**
Central & Eastern Europe	0.93	0.70	1.07	**1.51**	0.99	**1.82**	**3.36**	**1.22**
Non-Western-origin	0.93	**0.72**	1.02	**1.47**	**1.45**	**3.18**	**2.17**	**1.38**
Middle East	0.92	**0.49**	0.76	**1.47**	0.91	**4.05**	**2.47**	**1.27**
Central Southern America	0.90	0.83	**1.23**	**1.39**	**1.60**	**2.28**	0.81	**1.33**
Sub-Saharan Africa	0.82	0.52	**1.88**	**1.93**	**1.64**	**5.60**	**4.95**	**1.91**
Asia	0.99	1.09	0.90	**1.28**	**2.12**	**1.41**	**1.61**	**1.35**
Generation 2								
All	0.91	**1.06**	**1.31**	**1.39**	**1.40**	**1.99**	**2.02**	**1.34**
Western-origin	0.95	**1.13**	**1.36**	**1.38**	**1.42**	**1.86**	**1.85**	**1.35**
Finland	0.99	**1.34**	**1.62**	**1.69**	**1.72**	**2.33**	**1.87**	**1.60**
Other Nordic	0.88	1.02	**1.48**	**1.12**	**1.39**	**1.62**	0.94	**1.23**
Other Western	1.08	0.98	0.95	1.08	1.09	**1.18**	**2.46**	**1.10**
Central & Eastern Europe	0.78	0.93	**1.14**	**1.26**	**1.13**	**1.74**	**1.93**	**1.16**
Non-Western-origin	**0.59**	**0.59**	0.99	**1.40**	**1.24**	**2.82**	**3.08**	**1.24**
Middle East	**0.61**	0.66	0.93	**1.40**	0.98	**3.23**	**2.79**	**1.22**
Central Southern America	0.59	0.43	1.03	**1.68**	**1.35**	**2.30**	**2.71**	**1.28**
Sub-Saharan Africa	0.47	0.79	**1.22**	**1.38**	**1.97**	**3.96**	**5.83**	**1.60**
Asia	0.57	0.41	0.93	1.04	**1.36**	**1.49**	**2.63**	1.03

Notes: values significant to p<0.05 in bold; colour bands: lightest blue <=0.50; cyan 0.51-0.69; blue 0.70-0.89; grey 0.90-1.09; light pink 1.10-1.24; pink 1.25-1.49; dark pink 1.50-1.99; purple >=2.0; original extended regression models available in Tables S8-S12

Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Table 4. Age and birth cohort adjusted hazard ratios of cause-specific mortality *across* generation, western non-western origins, and lowest level origins in Sweden, 1997-2016, women aged 15-44.

Females	*Cancer*	*Circulatory*	*Other diseases*	*Accidents*	*Suicides*	*Other external*	*Ill-defined*	*All-causes*
Ancestral Swedes (REF)	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Generation 1								
All	1.00	**0.80**	**0.71**	**0.44**	**0.60**	1.22	**2.81**	**0.84**
Western-origin	1.05	0.87	**0.63**	**0.50**	**0.76**	**1.25**	**3.11**	**0.89**
Finland	**1.43**	**2.04**	1.36	1.22	**1.45**	**2.15**	2.05	**1.50**
Other Nordic	0.93	1.31	0.78	0.48	0.94	0.89	2.21	0.91
Other Western	**0.69**	**0.50**	**0.64**	**0.11**	**0.51**	0.61	**3.01**	**0.61**
Central & Eastern Europe	1.09	**0.66**	**0.46**	**0.46**	**0.66**	**1.31**	**3.51**	**0.85**
Non-Western-origin	0.97	**0.73**	**0.78**	**0.39**	**0.45**	**1.20**	**2.56**	**0.80**
Middle East	0.95	**0.51**	**0.40**	**0.27**	**0.26**	1.27	**2.07**	**0.65**
Central Southern America	0.88	0.82	**0.46**	**0.30**	0.68	0.52	**2.59**	**0.71**
Sub-Saharan Africa	1.22	1.40	**2.19**	0.64	**0.37**	**1.70**	**3.09**	**1.27**
Asia	0.88	0.69	**0.70**	**0.45**	**0.74**	1.04	**3.06**	**0.81**
Generation 15								
All	1.01	0.93	**1.20**	**1.23**	**1.76**	**1.64**	**2.14**	**1.25**
Western-origin	**1.19**	**1.23**	**1.27**	**1.17**	**1.56**	**1.37**	**1.77**	**1.29**
Finland	**1.49**	**1.81**	1.31	1.27	**2.10**	1.23	0.76	**1.53**
Other Nordic	**1.40**	1.34	1.47	0.99	1.19	**2.28**	**4.52**	**1.44**
Other Western	1.02	0.20	**1.73**	1.36	0.57	0.69	1.72	1.04
Central & Eastern Europe	0.89	1.07	0.98	1.05	**1.58**	1.51	1.88	**1.11**
Non-Western-origin	0.81	**0.60**	**1.13**	**1.30**	**1.97**	**1.92**	**2.53**	**1.21**
Middle East	**0.64**	**0.20**	1.07	1.30	1.19	**2.33**	1.65	0.97
Central Southern America	0.82	0.55	0.73	1.49	1.42	1.87	**3.87**	1.08
Sub-Saharan Africa	**1.16**	**2.22**	1.66	1.64	**2.66**	**1.26**	**9.37**	**1.85**
Asia	0.89	0.60	1.25	1.11	**2.88**	1.70	0.84	**1.33**
Generation 2								
All	0.98	1.01	**1.20**	**1.45**	**1.61**	**1.61**	**2.27**	**1.25**
Western-origin	1.02	1.05	**1.19**	**1.39**	**1.60**	**1.67**	**2.12**	**1.26**
Finland	0.97	**1.21**	**1.17**	**1.58**	**2.03**	**2.18**	**2.15**	**1.37**
Other Nordic	**1.16**	**1.12**	**1.39**	**1.19**	**1.40**	**1.53**	**1.52**	**1.27**
Other Western	0.96	0.88	1.09	**1.15**	1.04	1.08	**1.49**	1.03
Central & Eastern Europe	1.07	0.76	**1.14**	**1.42**	**1.44**	**1.22**	**3.41**	**1.22**
Non-Western-origin	**0.70**	0.68	**1.28**	**1.89**	**1.67**	**1.16**	**3.36**	**1.20**
Middle East	0.75	0.77	1.04	**2.60**	0.85	1.31	**4.19**	**1.16**
Central Southern America	0.48	-	**1.69**	0.45	**2.04**	**1.57**	**1.30**	1.00
Sub-Saharan Africa	0.27	**2.10**	**1.31**	**1.55**	**2.90**	0.89	**4.43**	**1.36**
Asia	1.00	0.29	**1.46**	**1.51**	**2.76**	0.50	**2.48**	**1.38**

Notes: values significant to p<0.05 in bold; colour bands: lightest blue <=0.50; cyan 0.51-0.69; blue 0.70-0.89; grey 0.90-1.09; light pink 1.10-1.24; pink 1.25-1.49; dark pink 1.50-1.99; purple >=2.0; original extended regression models available in Tables S8-S12

Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Often the information provided for such deaths is of low quality and a specific code cannot be assigned.

Otherwise, the **G1** tend to have lower mortality across the other causes of death. Mortality from accidents and suicides is particularly low relative to ancestral Swedes. The notable exception is **G1** Finns, especially men, who have a sizeable excess mortality from accidents and suicides. For other external causes, the hazard ratios are more variable across **G1** origins. For **G1** Finns, mortality is again elevated, now alongside **G1** both men and women from Sub-Saharan Africa. Additionally, other external mortality is elevated among **G1** women from the Middle East and Central & Eastern Europe. For natural causes of death, we can broadly generalise that mortality is lower among the **G1**. Of course, there are still some exceptions. **G1** Finns and Sub-Saharan Africans have higher mortality, relative to ancestral Swedes, from cancers, circulatory diseases, and other diseases & medical conditions. The magnitude of the hazard ratio for other diseases & medical conditions in **G1** Sub-Saharan African women is worth highlighting. It is also true that cancer and circulatory disease mortality are elevated in **G1** Central & Eastern European men.

For the **G15** and **G2** groups, we observe a broad consistency across causes of death. Mortality is similar to – or lower than (especially among descendants with non-Western origin groups) – the ancestral Swedes for cancers and circulatory diseases, similar to – or higher than (e.g., see **G15** and **G2** other Nordic men and women) – the ancestral Swedes for other diseases & medical conditions and typically elevated in the external cause of death groups. Highlighting specific examples, the hazard ratios for the category "other external causes" are particularly excessive among men who have non-Western origins, except among **G15** and **G2** Asians (even if their mortality is still elevated). Moreover, we observe very large hazard ratios for suicide mortality among **G15** and **G2** women from Central & Southern America, Sub-Saharan Africa, and also Asia.

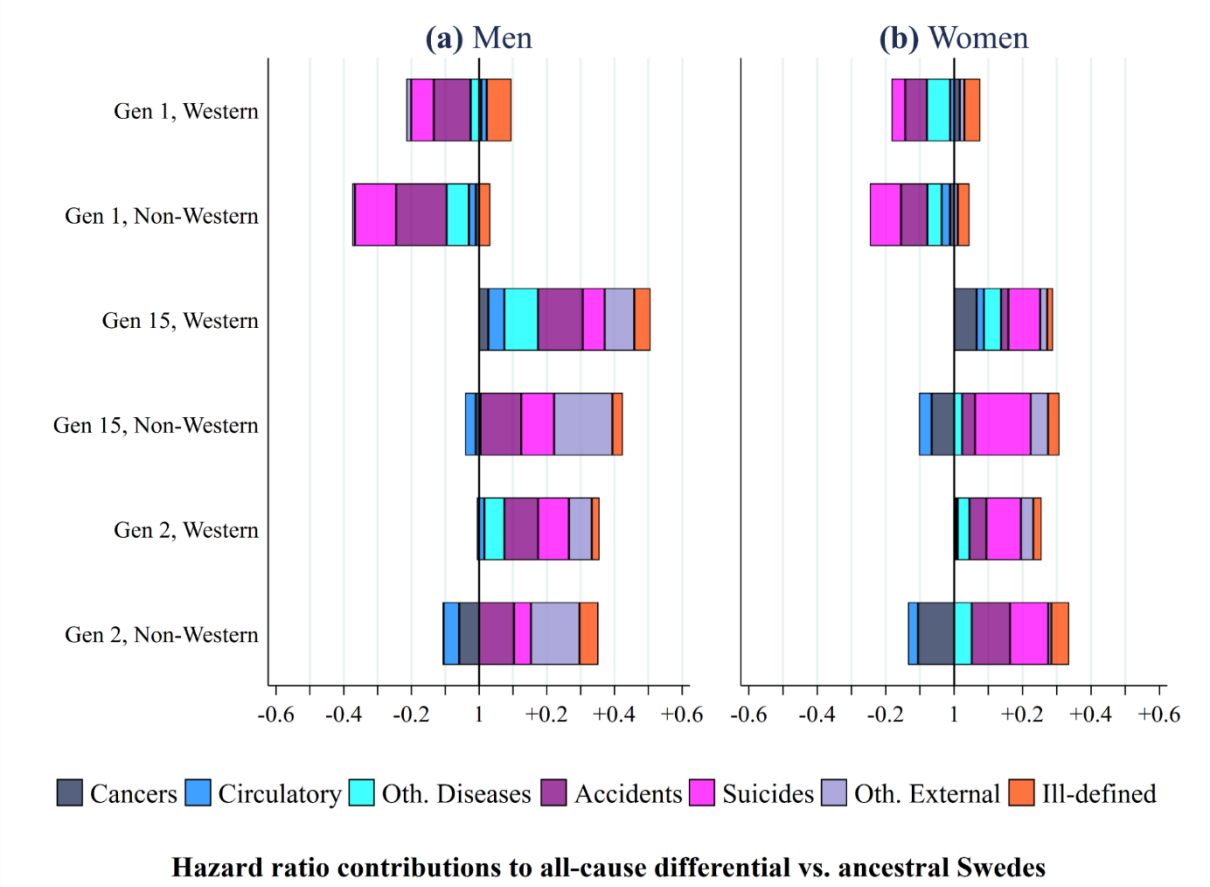

Figure 3. Hazard ratio contributions of causes of death to total mortality differences relative to ancestral Swedes, Sweden, 1997-2016, people aged 15-44. Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Comparing across generations, it is hard not point out the reversal in hazard ratios of mortality for the external cause categories between migrants and descendants of migrants. For example, hazard ratios for accidents (0.34 [0.21-0.54]), suicides (0.74 [0.53-1.03]), and for other external mortality (0.74 [0.43-1.30]) among **G1** Central & Southern American men that compare with, respectively, 1.39 (1.10-1.75), 1.60 (1.26-2.03), and 2.28 (1.63-3.18) among the **G15** and 1.68 (1.27-2.23), 1.35 (0.95-1.93), and 2.30 (1.47-3.60) among the **G2**. Men with origins in Central & Southern America are used simply as an example. The same pattern is true of nearly all of the generation-origin-sex combinations. That being said, the descendants of migrants – notably those with non-Western origins – appear to retain some mortality advantage (i.e., like the **G1**) from both cancers and circulatory diseases. Elsewhere, Finnish migrants and the descendants of Finnish migrants have a near systematic excess from all causes irrespective of generation or

sex. The magnitude of mortality of specific causes of death among both **G15** men and women from Sub-Saharan Africa, in the context of the **G1** and **G2**, constitutes a significant cause for concern.

Finally, figure 3 shows a stacked bar chart that places the cause-specific analyses in the context of the all-cause analysis. It takes full advantage of the extended survival setup to highlight the hazard ratio contributions of specific causes of death to the all-cause mortality hazard ratios in Figure 1. This is made possible by the extended model, because everything is estimated relative to a single reference point. As per Figure 2, I only show findings for western and non-western origin **G1**, **G15**, and **G2**. Lowest level contributions can be found in Figures S3-5. Values to the left of the reference line indicate that a cause of death contributes to the *depression* of the all-cause hazard ratio relative to ancestral Swedes; values to the right of this line indicate that a cause of death contributes to the *elevation* of the all-cause hazard ratio relative to ancestral Swedes. The supplementary materials shows how these contributions are derived from Models 2a-c.

Among the **G1**, we can see the crucial contribution that lower mortality from accidents and suicides (see Table 3 and Table 4) make to their lower all-cause hazard ratio relative to ancestral Swedes. Among **G1** Western-origin men, their advantage is almost exclusively generated by the three external causes of death categories, while among **G1** non-Western origin men and **G1** Western-origin and non-Western origin women, lower mortality from other diseases & medical conditions also provides some small contribution. Excess ill-defined mortality among all of the **G1** groups provide some counter elevation to their all-cause hazard ratios. Yet, the combination of all of these contributions works to generate the clear, net mortality advantages found among the **G1**. Among the **G15** and **G2**, the picture is near reversed. High accident, suicide, and other external mortality accounts (see Table 3 and Table 4) for nearly all of the elevation of their all-cause hazard ratio relative to ancestral Swedes. The main difference between Western and non-

Western origins is that, while cancers and circulatory diseases contribute to a depression of the all-cause hazard ratio among non-Western **G15** and **G2**, every cause contributes to an elevation of the all-cause hazard ratio among **G15** Western-origin and non-Western origin women and men. Concerning sex differences, we see the more prominent role of suicide mortality among **G15** and **G2** women and more prominent role of other external mortality among **G15** and **G2** men.

Discussion

The unique mortality patterns of international migrants have been documented extensively over the past several decades (Aldridge et al., 2018). However, we know comparatively less about adult mortality patterns among the *descendants* of migrants, who represent the fastest growing sector of younger populations in a number of the world's migrant-receiving countries (Suárez-Orozco, 2018). The evidence thus far suggests that the descendants of migrants do not benefit from the same mortality advantage as migrants and may well be disadvantaged relative to the ancestral populations of host countries (De Grande et al., 2014; Guillot et al., 2019; Khlat et al., 2019; Manhica et al., 2015; Mehta et al., 2019; Singh & Siahpush, 2001; Tarnutzer et al., 2012; Vandenheede et al., 2014; Vandenheede et al., 2015; Wallace, 2016). Here, my two aims were to build upon the literature by (1) documenting all-cause mortality differentials between migrants and descendants of migrants in Sweden and (2) revealing the specific causes of death driving the differences. The aims were achieved by answering four specific and related research questions.

Regarding **RQ1,** a migrant mortality advantage was found among most **G1** groups except for Finns and Sub-Saharan Africans, who had excess mortality. A disadvantage was found among nearly all **G15** and **G2** groups, particularly among men. Regarding **RQ2**, men, accidents and suicides were the leading causes of death among ancestral Swedish men and male descendants

of migrants (especially non-Western-origin). For **G1** men, cancer – and not an external cause – was the leading cause of death. Among women, cancer was the leading cause of death in all groups except for **G15** and **G2** women with non-Western-origins, for whom suicide was the leading cause of death. Regarding **RQ3**, the **G1** – except Finns and Sub-Saharan Africans – generally had lower mortality across all causes of death, except for ill-defined causes. The **G15** and **G2**, much like the **G1**, generally had lower mortality from cancers and circulatory diseases. Unlike the **G1**, however, they had higher mortality across all other causes of death. Regarding **RQ4,** quite simply, accidents, suicides, and other external causes of death were driving both the mortality advantage of migrants *and* the mortality disadvantage of descendants of migrants. Finally, regarding **RQ5**, the mortality of the **G15** more closely resembled the mortality of the **G2**, both in the magnitude of the overall excesses observed and in the specific causes of death profile.

This is one of the first times that this intergenerational reversal in the all-cause mortality risk of migrants and descendants of migrants has been directly *observed* in Sweden, beyond a study of the **G1** and **G2** with type-2 diabetes (Bennet et al., 2020). The results are broadly consistent with this study and studies that have examined mortality among migrants (Honkaniemi et al., 2017; Juárez et al., 2018; Oksuzyan et al., 2019; Wallace & Wilson, 2020) and the descendants of migrants (Manhica et al., 2015; Mehta et al., 2019) separately. The results add weight to the small body of international evidence also documenting this reversal (see e.g., De Grande et al., 2014; Guillot et al., 2019; Khlat et al., 2019; Manhica et al., 2015; Mehta et al., 2019; Singh & Siahpush, 2001; Tarnutzer et al., 2012; Vandenheede et al., 2014; Vandenheede et al., 2015; Wallace, 2016). The provision of detailed estimates on cause-of-death that showed within *and* across group variation, and how this combined to generate the all-cause mortality differentials, represents a big step forward in a literature that has lacked such analyses. As does the provision of estimates for the **G15**. Very few, if any, studies have provided direct (i.e., defining the group,

rather than adjusting age at arrival) and detailed evidence of the mortality patterns in this unique group.

What could explain the findings? Previous research would seem to rule out a substantial out-selection (or salmon bias) effect (Abraído-Lanza et al., 1999; Andersson & Drefahl, 2017; Lu & Qin, 2014; Turra & Elo, 2008; Wallace & Kulu, 2014a, 2018) or unregistered emigration-related effect on lower migrant mortality (Razum et al., 2000; Wallace & Kulu, 2014b; Wallace & Wilson, 2020). It is also true that the deaths of residents abroad are captured in the Swedish cause-of-death register, even if events cannot always be assigned an ICD-code (Brooke et al., 2017). Moreover, the **G15** are also subjected to the same potential biases as the **G1**, yet their mortality risk is clearly elevated in most groups relative to the ancestral Swedish population. If there is a sizeable bias then this suggests that the excess mortality of the **G15** is also under-estimated.

The results would also seem to provide evidence against a lack of health selection effects being the main mechanism operating to reverse mortality risks between migrants and the descendants of migrants. In particular, the magnitude of the overall mortality hazard ratios for the **G15** and **G2** (would the absence of selection alone generate such a sizeable excess mortality?) and that their excess is focused in the external and not natural (i.e., health-determinable) cause groups. This selection narrative is also complicated by the **G15**, who *do* experience migration (even if they do not "self-select") and share many common characteristics with their parents that might indirectly be associated with a positive selection (e.g., SES in the country of origin, household wealth).

The results do not provide a lot of evidence in favour of cultural effects as primary mechanism either. If greater adaptation among descendants of migrants away from the health behaviours of the origin society and toward the health behaviours of the host society were responsible,

then we would expect to find some evidence of this in the causes of death influenced by health behaviours such as smoking, alcohol consumption, and diet. This is the case for other diseases & medical conditions among the **G15** and **G2**, which tend to be elevated relative to the **G1** and the ancestral Swedes. However, the cancer and circulatory disease mortality of the **G15** and **G2** reflect the lower levels of the **G1** as opposed to the higher levels of the ancestral Swedes. Could this be because the **G15** and **G2** are dying from external causes before any diseases can develop?

The findings from this study *do* seem to be consistent with some of the theory related to psycho-social factors. To elaborate, lower mortality among the **G1** from external causes of death (and especially accidents) certainly speaks to a more risk-averse nature among migrants. However, does this mean that the excess mortality of the **G15** and **G2** from accidents and other external causes (i.e., poisonings and homicides) speak to a *risk-seeking* nature? The very limited inter-generational evidence from the literature would suggest otherwise. A German study found that while risk attitudes among the descendants of migrants are higher than among migrants, they are no higher than they are among the ancestral native-born (Bonin et al., 2009). It is also true that suicide mortality is elevated in the **G15** and **G2** and especially among non-Western-origin groups, who are most likely to be subjected to racism and discrimination. Prior work on suicide mortality in Sweden has offered a similar explanation for these patterns (Hjern & Allebeck, 2002).

It is beyond the scope of this study to discuss the evidence in relation to the potential impact of social conditions. It was not the intention of this study to do so, not least because different social factors might not influence mortality from specific causes of death in the same away and a limitation of the extended method is that the effect of the covariates is assumed to be the same across causes of death (Wallace & Kulu, 2015). One could refer to the recent article by Manhica et al (2015), which focused on the respective roles of education and income on the mortality of

a combined **G15** and **G2** in Sweden. Several studies in other countries have also adopted a similar focus on social conditions (Grande et al., 2014; Myriam Khlat et al., 2019; Wallace, 2016).

There are many strengths to this study. Of course, the use of high-quality total population data and advanced methods to analyse the mortality of populations in Sweden. Next, the adoption of an intergenerational perspective to investigate mortality among migrant-origin populations. Third, the provision of estimates at a granular level of origins, more so than in many previous studies. Fourth, the provision of mortality estimates for the **G15**, an under-researched group in migrant mortality research. Finally, a thorough investigation of mortality by detailed causes of death, including demonstrating exactly how specific causes of death contribute to the overall mortality differentials. Potential weaknesses include an inability to examine in more detail the causes of death comprising the groups other diseases & medical conditions and other external causes *and* in more detail at some of the countries comprising lower-level origins. Moreover, the necessary age restrictions meant that I did not examine older life mortality among migrants and some of the older Western-origin G15 and G2. At ages beyond 45, as senescent deaths take over, external mortality is unlikely to play a key role in mortality differentials. Future research could look to which causes are key to generating the low mortality or not of older migrants in Sweden.

Overall, I have demonstrated that the mortality advantage of migrants in Sweden is reversed among the descendants of migrants aged 15-44. This stark reversal in all-cause mortality risk is driven by an increase across generations in mortality from accidents, suicides, other external causes, and other diseases & medical conditions. The specific cause of death patterns and the additional insight provided by including estimates for the **G15** provide evidence against the prominent role of mechanisms such as a loss of selection effects between generations and offer more weight to factors related to the adverse experience of being an ethnic minority in Sweden.

With such an overlap in the mortality profile of the **G15** and **G2**, and their commonality being that they grow up in the host country, future research should endeavour to examine the impact of factors associated explicitly with these formative years on the adult mortality of the **G15** and **G2**. These findings lead to concerns about the success of long-run integration processes among migrant-origin populations in Sweden. They identify the **G15** and **G2,** and specific groups such as Sub-Saharan Africans, as both current and future public health concerns. The descendants of migrants are dying at ages at which they do not need to die from causes of death that are preventable.

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Funding

Work was supported by the Swedish Research Council for Health, Working Life and Welfare (*Forte*): **2019-00603** '*Migrant mortality advantage lost? Emerging lifespan inequalities among migrants and their descendants in Sweden*'; **2016-07105** '*Migrant Trajectories*'; and **2016–07115** '*Ageing Well*'.

Supplementary materials

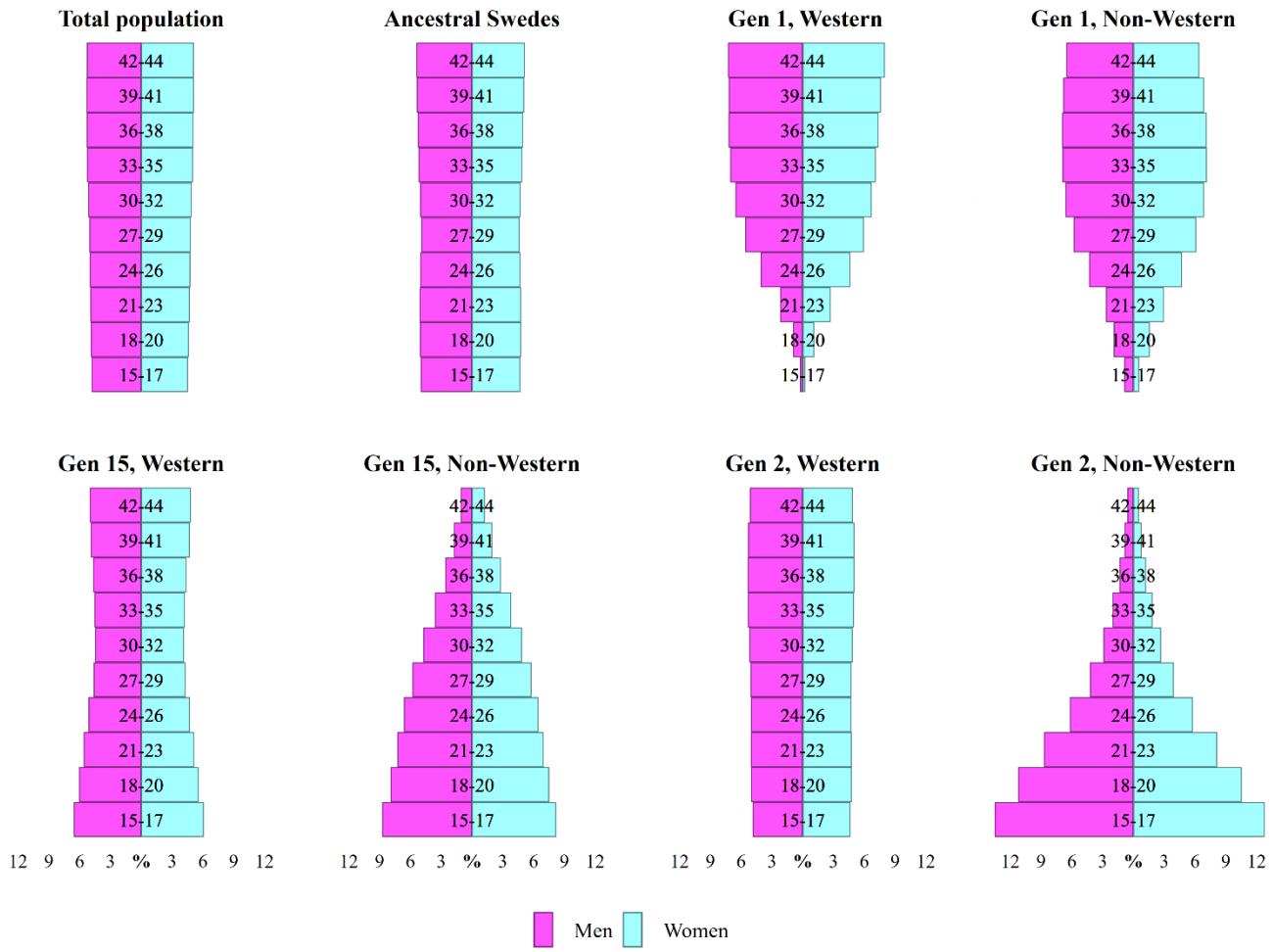


Figure S1. Population age distributions, generation by western and non-western origins, Sweden, 1997-2016.

Source: author's calculation based upon the Swedish register data collection "Ageing Well"

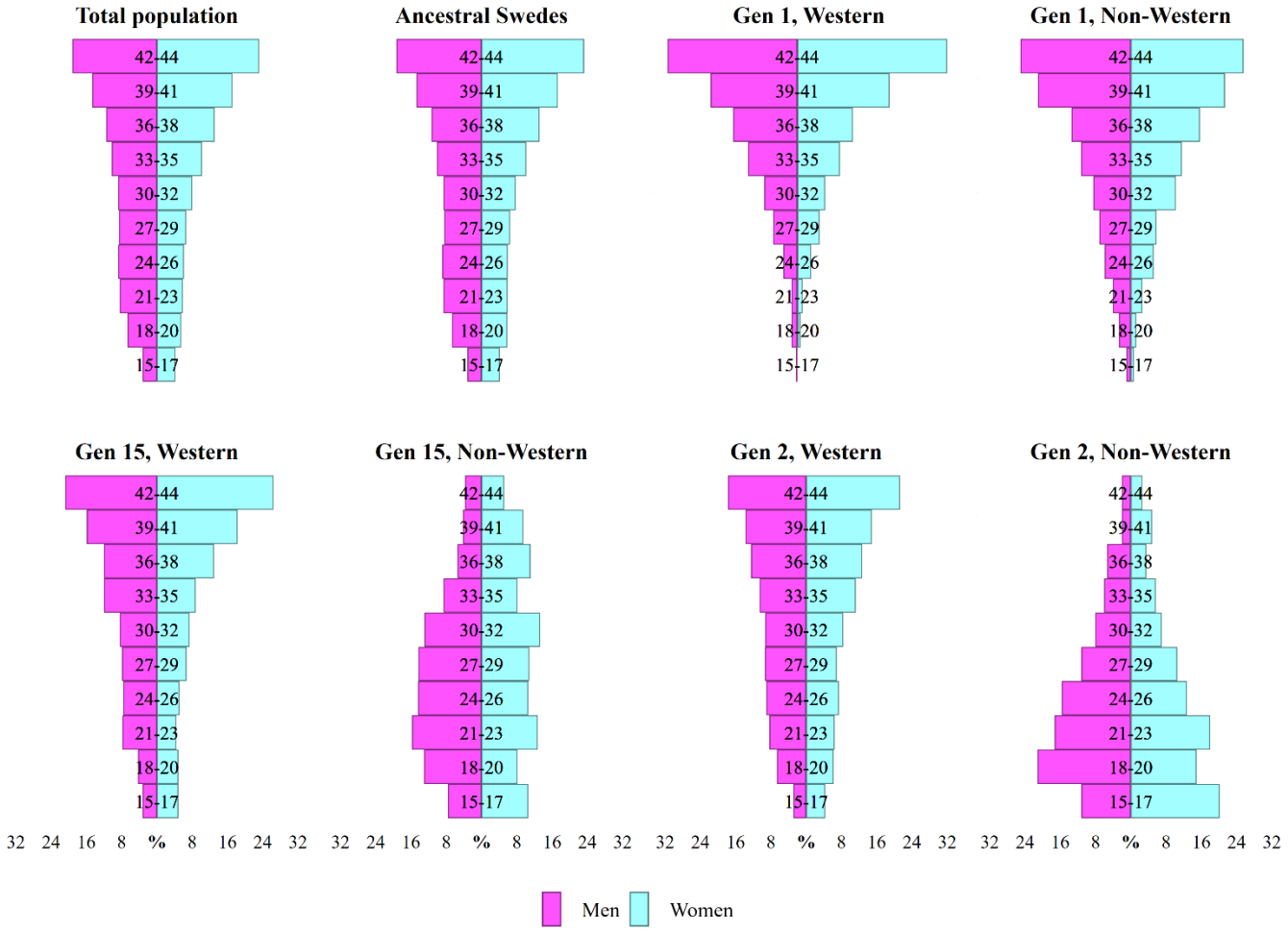
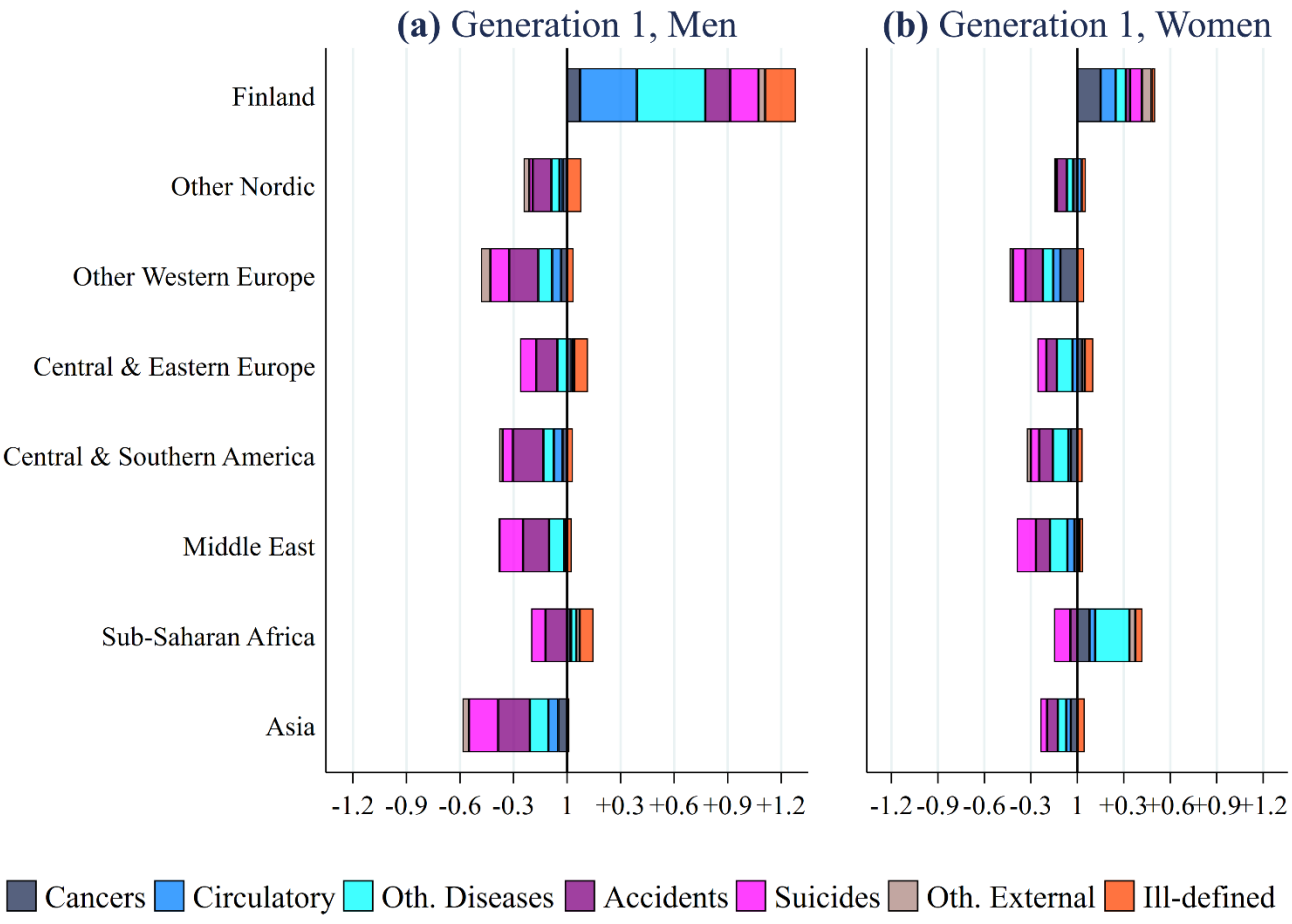
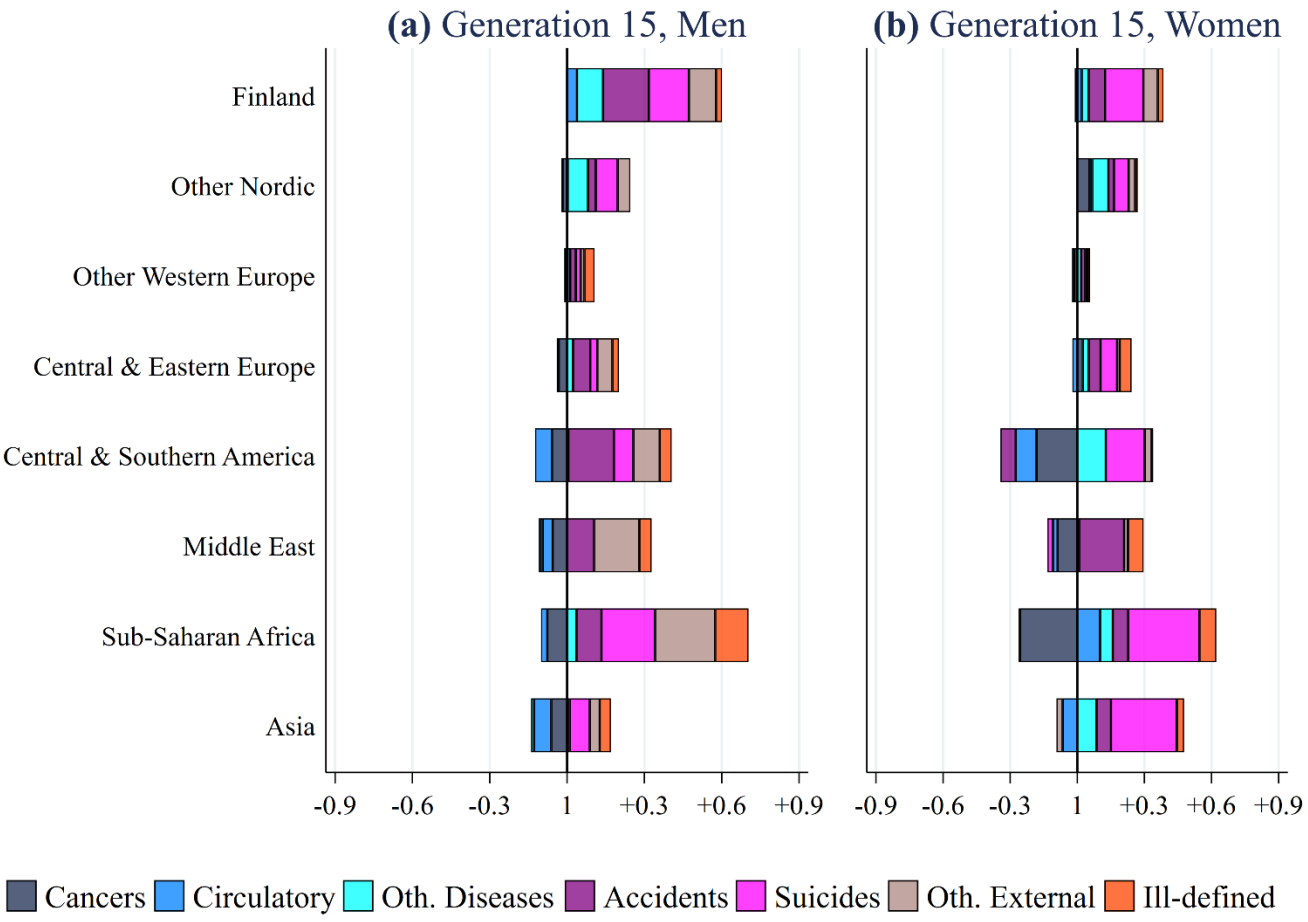


Figure S2. Age-at-death distributions, generation by western and non-western origins, Sweden, 1997-2016.
Source: author's calculation based upon the Swedish register data collection "Ageing Well"



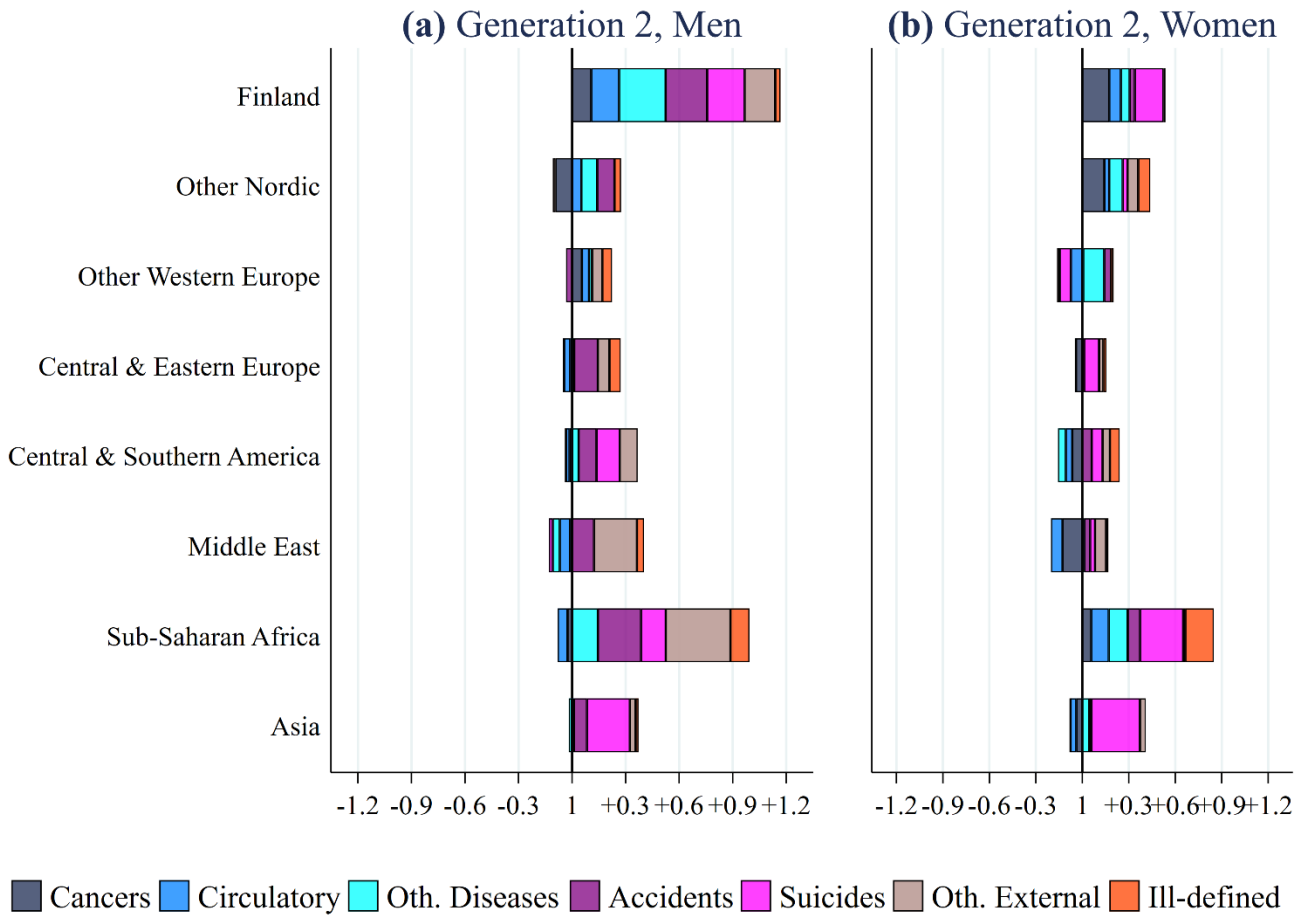
Hazard ratio contributions of specific causes to all-cause differentials vs. ancestral Swedes

Figure S3. Contributions of specific causes of death to all-cause mortality differences between the **G1** and ancestral Swedes, lowest level origins, ages 15-44, 1997-2016.
Source: author's calculation based upon the Swedish register data collection "Ageing Well"



Hazard ratio contributions of specific causes to all-cause differentials vs. ancestral Swedes

Figure S4. Contributions of specific causes of death to all-cause mortality differences between the **G15** and ancestral Swedes, lowest level origins, ages 15-44, 1997-2016.
Source: author's calculation based upon the Swedish register data collection "Ageing Well"



Hazard ratio contributions of specific causes to all-cause differentials vs. ancestral Swedes

Figure S5. Contributions of specific causes of death to all-cause mortality differences between the **G2** and ancestral Swedes, lowest level origins, ages 15-44, 1997-2016.
Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Table S1. Model 1a, extended, competing-risks survival model, people aged 15-44, 1997-2016, generational level.

Model 1a	Men				Women			
	HR	Sig.	95%CIs		HR	Sig.	95%CIs	
Generation								
Ancestral Swedes	**1**							
Generation 1	0.76	**	0.73	0.79	0.84	**	0.80	0.89
Generation 15	1.45	**	1.38	1.52	1.25	**	1.16	1.34
Generation 2	1.34	**	1.29	1.38	1.25	**	1.19	1.31
Birth year	0.99	**	0.99	0.99	0.99	**	0.98	0.99
Cause of death								
Cancer	**1**							
Circulatory diseases	0.80	**	0.77	0.84	0.25	**	0.24	0.27
Other diseases	1.18	**	1.13	1.23	0.52	**	0.50	0.55
Accidents	1.84	**	1.77	1.91	0.35	**	0.33	0.37
Suicides	1.53	**	1.47	1.59	0.50	**	0.47	0.52
Other external	0.65	**	0.62	0.68	0.17	**	0.16	0.19
Ill-defined	0.27	**	0.25	0.29	0.09	**	0.08	0.10

Notes: p<0.01 **; p<0.05 *; p<0.1 +
Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Table S2. Model 1b, extended, competing-risks survival model, people aged 15-44, 1997-2016, generation by western, non-western origins.

Model 1b	**Men**			**Women**		
	HR	Sig.	95%CIs	HR	Sig.	95%CIs
Generation						
Ancestral Swedes	**1**					
Generation 1						
Western	0.88	**	0.83 - 0.93	0.89	**	0.83 - 0.96
Non-Western	0.66	**	0.62 - 0.70	0.80	**	0.74 - 0.86
Generation 15						
Western	1.51	**	1.41 - 1.60	1.29	**	1.17 - 1.42
Non-Western	1.38	**	1.29 - 1.48	1.21	**	1.09 - 1.34
Generation 2						
Western	1.35	**	1.30 - 1.40	1.26	**	1.19 - 1.32
Non-Western	1.25	**	1.14 - 1.36	1.20	**	1.05 - 1.37
Birth year	0.99	**	0.99 - 0.99	0.99	**	0.98 - 0.99
Cause of death						
Cancer	**1**					
Circulatory diseases	0.80	**	0.77 - 0.84	0.25	**	0.24 - 0.27
Other diseases	1.18	**	1.13 - 1.23	0.52	**	0.50 - 0.55
Accidents	1.84	**	1.77 - 1.91	0.35	**	0.33 - 0.37
Suicides	1.53	**	1.47 - 1.59	0.50	**	0.47 - 0.52
Other external	0.65	**	0.62 - 0.68	0.17	**	0.16 - 0.19
Ill-defined	0.27	**	0.25 - 0.29	0.09	**	0.08 - 0.10

Notes: p<0.01 **; p<0.05 *; p<0.1 +
Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Table S3. Model 1c, extended, competing-risks survival model, people aged 15-44, 1997-2016, generation by lowest level origins.

Model 1c	Men			Women		
	HR	Sig.	95%CIs	HR	Sig.	95%CIs
Generation						
Ancestral Swedes	**1**					
Generation 1						
Finland	2.28	**	2.03 - 2.57	1.50	**	1.29 - 1.75
Other Nordic	0.84	*	0.71 - 0.99	0.91		0.72 - 1.14
Other Western	0.55	**	0.49 - 0.63	0.61	**	0.49 - 0.74
Central & Eastern Europe	0.85	**	0.79 - 0.92	0.85	**	0.77 - 0.93
The Middle East	0.64	**	0.59 - 0.69	0.65	**	0.58 - 0.73
Central Southern America	0.65	**	0.54 - 0.79	0.71	**	0.56 - 0.89
Sub-Saharan Africa	0.95		0.85 - 1.06	1.27	**	1.11 - 1.46
Asia	0.43	**	0.36 - 0.50	0.81	**	0.71 - 0.92
Generation 15						
Finland	2.17	**	1.98 - 2.38	1.53	**	1.32 - 1.77
Other Nordic	1.17		0.95 - 1.43	1.44	**	1.11 - 1.86
Other Western	1.19	*	1.00 - 1.41	1.04		0.80 - 1.35
Central & Eastern Europe	1.22	**	1.10 - 1.36	1.11		0.94 - 1.32
The Middle East	1.27	**	1.15 - 1.42	0.97		0.80 - 1.17
Central Southern America	1.33	**	1.15 - 1.54	1.08		0.85 - 1.39
Sub-Saharan Africa	1.91	**	1.61 - 2.27	1.85	**	1.41 - 2.42
Asia	1.35	**	1.19 - 1.55	1.33	**	1.13 - 1.57
Generation 2						
Finland	1.60	**	1.53 - 1.67	1.37	**	1.28 - 1.47
Other Nordic	1.23	**	1.13 - 1.33	1.27	**	1.13 - 1.42
Other Western	1.10	*	1.01 - 1.18	1.03		0.92 - 1.16
Central & Eastern Europe	1.16	**	1.07 - 1.26	1.22	**	1.09 - 1.37
The Middle East	1.22	**	1.08 - 1.37	1.16		0.97 - 1.40
Central Southern America	1.28	*	1.06 - 1.55	1.00		0.71 - 1.39
Sub-Saharan Africa	1.60	**	1.27 - 2.02	1.36		0.94 - 1.97
Asia	1.03		0.84 - 1.27	1.38	*	1.05 - 1.82
Birth year	0.99	**	0.99 - 0.99	0.99	**	0.98 - 0.99
Cause of death						
Cancer	**1**					
Circulatory diseases	0.80	**	0.77 - 0.84	0.25	**	0.24 - 0.27
Other diseases	1.18	**	1.13 - 1.23	0.52	**	0.50 - 0.55
Accidents	1.84	**	1.77 - 1.91	0.35	**	0.33 - 0.37
Suicides	1.53	**	1.47 - 1.59	0.50	**	0.47 - 0.52
Other external	0.65	**	0.62 - 0.68	0.17	**	0.16 - 0.19
Ill-defined	0.27	**	0.25 - 0.29	0.09	**	0.08 - 0.10

Notes: p<0.01 **; p<0.05 *; p<0.1 +

Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Table S4. Deaths by cause among generations by lowest level origins, men.

Men	CAN	CIR	DIS	ACC	SUI	EXT	ILL	TOT
Ancestral Swedes	2,907	2,292	3,326	5,249	4,357	1,597	542	20,270
Generation 1								
Finland	26	52	66	48	45	14	24	275
Other Nordic	20	16	20	26	33	8	18	141
Other Western	47	27	37	41	47	11	27	237
Central Eastern Europe	131	98	85	109	97	63	80	663
The Middle East	147	106	83	119	87	77	55	674
Central Southern America	20	11	18	15	27	10	10	111
Sub-Saharan Africa	53	38	63	45	44	32	34	309
Asia	31	19	20	27	17	14	13	141
Generation 15								
Finland	53	57	90	104	90	53	12	459
Other Nordic	<5	13	20	28	17	5	5	9X
Other Western	22	17	20	25	24	15	9	132
Central Eastern Europe	37	22	49	109	59	40	25	341
The Middle East	36	15	34	104	53	87	18	347
Central Southern America	18	13	28	50	48	25	<5	18X
Sub-Saharan Africa	8	<5	21	34	24	30	9	13X
Asia	23	20	24	54	74	18	7	220
Generation 2								
Finland	176	188	329	542	460	228	62	1,985
Other Nordic	60	55	116	138	143	61	12	585
Other Western	97	69	97	175	146	58	41	683
Central Eastern Europe	56	53	94	164	122	69	26	584
The Middle East	20	17	35	83	48	58	17	278
Central Southern America	7	<5	14	36	24	15	6	10X
Sub-Saharan Africa	<5	<5	9	16	19	14	7	7X
Asia	7	<5	13	23	25	10	6	8X
TOT	4,00X	3,21X	4,711	7,364	6,310	2,612	1,06X	29,108

Notes: cells with less than 5 events anonymised to comply with terms and conditions of data supplier; CAN = cancer; CIR = circulatory diseases; DIS = other diseases & medical conditions; ACC = accidents; SUI = suicides; EXT = other external causes of death; ILL = ill-defined causes; TOT = total (as rows or columns)
Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Table S5. Deaths by cause among generations by lowest level origins, women.

Women	CAN	CIR	DIS	ACC	SUI	EXT	ILL	TOT
Ancestral Swedes	3,543	929	1,862	1,259	1,677	546	220	10,036
Generation 1								
Finland	56	21	28	17	27	13	5	167
Other Nordic	27	10	12	5	13	<5	<5	7X
Other Western	37	7	18	<5	13	5	10	9X
Central Eastern Europe	200	32	44	30	57	37	40	440
The Middle East	155	22	34	16	20	32	21	300
Central Southern America	33	8	9	<5	12	<5	6	7X
Sub-Saharan Africa	70	21	66	13	10	15	11	206
Asia	88	18	37	16	35	16	19	229
Generation 15								
Finland	63	20	29	19	42	8	<5	18X
Other Nordic	20	5	11	5	8	<5	<5	5X
Other Western	19	<5	17	9	5	<5	<5	5X
Central Eastern Europe	38	12	22	16	32	10	5	135
The Middle East	25	<5	22	18	22	14	<5	10X
Central Southern America	17	<5	8	11	14	6	5	6X
Sub-Saharan Africa	12	6	9	6	13	<5	6	5X
Asia	34	6	25	15	52	10	<5	14X
Generation 2								
Finland	210	69	133	122	208	73	29	844
Other Nordic	98	25	62	36	56	20	8	305
Other Western	104	25	62	44	53	18	10	316
Central Eastern Europe	91	17	51	43	58	16	18	294
The Middle East	26	7	19	32	14	7	9	114
Central Southern America	6	<5	11	<5	12	<5	<5	3X
Sub-Saharan Africa	<5	<5	5	<5	10	<5	<5	2X
Asia	13	<5	10	7	17	<5	<5	5X
TOT	4,98X	1,27X	2,60X	1,75X	2,48X	86X	44X	29,108

Notes: cells with less than 5 events anonymised to comply with terms and conditions of data supplier; CAN = cancer; CIR = circulatory diseases; DIS = other diseases & medical conditions; ACC = accidents; SUI = suicides; EXT = other external causes of death; ILL = ill-defined causes; TOT = total (as rows or columns)
Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Table S6. Age and birth cohort adjusted hazard ratios of cause-specific mortality *within* generation by lowest level origin groups, men in Sweden, 1997-2016, ages 15-44.

Males	*Cancer*	*Circulatory*	*Other diseases and medical conditions*	*Accidents*	*Suicides*	*Other external*	*Ill-defined*	**Leading cause of death**
Total population	1	**0.80**	**1.18**	**1.84**	**1.53**	**0.65**	**0.27**	*Accidents*
Ancestral Swedes	1	**0.79**	**1.14**	**1.81**	**1.50**	**0.55**	**0.19**	*Accidents*
Generation 1								
Finland	1	**2.00**	**2.54**	**1.85**	**1.73**	0.54	0.92	*Other diseases*
Other Nordic	1	0.80	1.00	1.30	1.65	**0.40**	0.90	*Suicides*
Other Western	1	**0.57**	0.79	0.87	1.00	**0.23**	**0.57**	*Cancers & suicides*
Central Eastern Europe	1	**0.75**	**0.65**	0.83	**0.74**	**0.48**	**0.61**	*Cancers*
The Middle East	1	**0.72**	**0.56**	0.81	**0.59**	**0.52**	**0.37**	*Cancers*
Central Southern America	1	0.55	0.90	0.75	1.35	0.50	0.50	*Suicides*
Sub-Saharan Africa	1	0.72	1.19	0.85	0.83	**0.60**	**0.65**	*Other diseases*
Asia	1	0.61	0.65	0.87	**0.55**	**0.45**	**0.42**	*Cancers*
Generation 15								
Finland	1	1.08	**1.70**	**1.96**	**1.70**	1.00	**0.23**	*Accidents*
Other Nordic	1	**3.25**	**5.00**	**7.00**	**4.25**	1.25	1.25	*Accidents*
Other Western	1	0.77	0.91	1.14	1.09	0.68	**0.41**	*Accidents*
Central Eastern Europe	1	**0.59**	1.32	**2.95**	**1.59**	1.08	0.68	*Accidents*
The Middle East	1	**0.42**	0.94	**2.89**	1.47	**2.42**	**0.50**	*Accidents*
Central Southern America	1	0.72	1.56	**2.78**	**2.67**	1.39	**0.17**	*Accidents*
Sub-Saharan Africa	1	0.50	**2.63**	**4.25**	**3.00**	**3.75**	1.13	*Accidents*
Asia	1	0.87	1.04	**2.35**	**3.22**	0.78	**0.30**	*Suicides*
Generation 2								
Finland	1	1.07	**1.87**	**3.08**	**2.61**	**1.30**	**0.35**	*Accidents*
Other Nordic	1	0.92	**1.93**	**2.30**	**2.38**	1.02	**0.20**	*Suicides*
Other Western	1	**0.71**	1.00	**1.80**	**1.51**	**0.60**	**0.42**	*Accidents*
Central Eastern Europe	1	0.95	**1.68**	**2.93**	**2.18**	1.23	**0.46**	*Accidents*
The Middle East	1	0.85	**1.75**	**4.15**	**2.40**	**2.90**	0.85	*Accidents*
Central Southern America	1	0.57	2.00	**5.14**	**3.43**	2.14	0.86	*Accidents*
Sub-Saharan Africa	1	1.33	3.00	**5.33**	**6.33**	**4.67**	2.33	*Suicides*
Asia	1	0.57	1.86	**3.29**	**3.57**	1.43	0.86	*Suicides*

Notes: values significant to $p<0.05$ in bold; values derived from Model 2c (Table S11)
Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Table S7. Age and birth cohort adjusted hazard ratios of cause-specific mortality *within* generation by lowest level origin groups, women in Sweden, 1997-2016, ages 15-44.

Females	*Cancer*	*Circulatory*	*Other diseases and medical conditions*	*Accidents*	*Suicides*	*Other external*	*Ill-defined*	**Leading cause of death**
Total population	1	**0.25**	**0.52**	**0.35**	**0.50**	**0.17**	**0.09**	*Cancers*
Ancestral Swedes	1	**0.26**	**0.53**	**0.36**	**0.47**	**0.15**	**0.06**	*Cancers*
Generation 1								
Finland	1	**0.38**	**0.50**	**0.30**	**0.48**	**0.23**	**0.09**	*Cancers*
Other Nordic	1	**0.37**	**0.44**	**0.19**	**0.48**	**0.15**	**0.15**	*Cancers*
Other Western	1	**0.19**	**0.49**	**0.05**	**0.35**	**0.14**	**0.27**	*Cancers*
Central Eastern Europe	1	**0.16**	**0.22**	**0.15**	**0.29**	**0.19**	**0.20**	*Cancers*
The Middle East	1	**0.14**	**0.22**	**0.10**	**0.13**	**0.21**	**0.14**	*Cancers*
Central Southern America	1	**0.24**	**0.27**	**0.12**	**0.36**	**0.09**	**0.18**	*Cancers*
Sub-Saharan Africa	1	**0.30**	0.94	**0.19**	**0.14**	**0.21**	**0.16**	*Cancers*
Asia	1	**0.20**	**0.42**	**0.18**	**0.40**	**0.18**	**0.22**	*Cancers*
Generation 15								
Finland	1	**0.32**	**0.46**	**0.30**	**0.67**	**0.13**	**0.03**	*Cancers*
Other Nordic	1	**0.25**	0.55	**0.25**	**0.40**	**0.25**	**0.20**	*Cancers*
Other Western	1	**0.05**	0.89	**0.47**	**0.26**	**0.11**	**0.11**	*Cancers*
Central Eastern Europe	1	**0.32**	**0.58**	**0.42**	0.84	**0.26**	**0.13**	*Cancers*
The Middle East	1	**0.08**	0.88	0.72	0.88	**0.56**	**0.16**	*Cancers*
Central Southern America	1	**0.17**	0.47	0.65	0.82	**0.35**	**0.29**	*Cancers*
Sub-Saharan Africa	1	0.50	0.75	0.50	1.08	**0.17**	0.50	*Suicides*
Asia	1	**0.18**	0.74	**0.44**	1.53	**0.29**	**0.06**	*Cancers*
Generation 2								
Finland	1	**0.33**	**0.63**	**0.58**	0.99	**0.35**	**0.14**	*Cancers*
Other Nordic	1	**0.26**	**0.63**	**0.37**	**0.57**	**0.20**	**0.08**	*Cancers*
Other Western	1	**0.24**	**0.60**	**0.42**	**0.51**	**0.17**	**0.10**	*Cancers*
Central Eastern Europe	1	**0.19**	**0.56**	**0.47**	**0.64**	**0.18**	**0.20**	*Cancers*
The Middle East	1	**0.27**	0.73	1.23	**0.54**	**0.27**	**0.35**	*Accidents*
Central Southern America	1	-	1.83	0.33	2.00	0.50	0.17	*Suicides*
Sub-Saharan Africa	1	2.00	2.50	2.00	**5.00**	0.50	1.00	*Suicides*
Asia	1	**0.07**	0.77	0.54	1.31	**0.08**	**0.15**	*Suicides*

Notes: values significant to $p<0.05$ in bold; values derived from Model 2c (Table S12)
Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Table S8. Model 2a, extended, competing-risks survival model, people aged 15-44, 1997-2016, generational level, cancer among ancestral Swedes as reference.

Model 2a	Men			Women		
	HR	Sig.	95%CIs	HR	Sig.	95%CIs
Generation by cause						
Cancer						
Ancestral Swedes	**1**			**1**		
Generation 1	0.98		0.89 - 1.08	1.00		0.92 - 1.09
Generation 15	1.07		0.92 - 1.23	1.01		0.88 - 1.15
Generation 2	0.91	+	0.82 - 1.00	0.98		0.90 - 1.07
Circulatory diseases						
Ancestral Swedes	0.79	**	0.75 - 0.83	0.26	**	0.24 - 0.28
Generation 1	0.76	**	0.68 - 0.85	0.21	**	0.18 - 0.25
Generation 15	0.85	*	0.73 - 1.00	0.24	**	0.19 - 0.32
Generation 2	0.84	**	0.75 - 0.93	0.26	**	0.22 - 0.31
Other diseases						
Ancestral Swedes	1.14	**	1.09 - 1.20	0.53	**	0.50 - 0.56
Generation 1	0.81	**	0.73 - 0.90	0.37	**	0.33 - 0.42
Generation 15	1.52	**	1.34 - 1.71	0.63	**	0.54 - 0.75
Generation 2	1.50	**	1.38 - 1.63	0.63	**	0.56 - 0.70
Accidents						
Ancestral Swedes	1.81	**	1.73 - 1.89	0.36	**	0.33 - 0.38
Generation 1	0.89	*	0.80 - 0.98	0.16	**	0.13 - 0.19
Generation 15	2.69	**	2.45 - 2.96	0.44	**	0.36 - 0.54
Generation 2	2.50	**	2.34 - 2.68	0.52	**	0.46 - 0.58
Suicides						
Ancestral Swedes	1.50	**	1.43 - 1.57	0.47	**	0.45 - 0.50
Generation 1	0.82	**	0.74 - 0.91	0.28	*	0.24 - 0.33
Generation 15	2.06	**	1.85 - 2.29	0.83	**	0.72 - 0.96
Generation 2	2.10	**	1.95 - 2.26	0.76	**	0.69 - 0.84
Other external						
Ancestral Swedes	0.55	**	0.52 - 0.58	0.15	**	0.14 - 0.17
Generation 1	0.47	**	0.41 - 0.54	0.19	**	0.16 - 0.23
Generation 15	1.45	**	1.28 - 1.64	0.25	**	0.19 - 0.33
Generation 2	1.09	+	0.99 - 1.20	0.25	**	0.21 - 0.29
Ill-defined						
Ancestral Swedes	0.19	**	0.17 - 0.20	0.06	**	0.05 - 0.07
Generation 1	0.54	**	0.48 - 0.61	0.17	**	0.15 - 0.21
Generation 15	0.47	**	0.38 - 0.58	0.13	**	0.09 - 0.19
Generation 2	0.38	**	0.32 - 0.44	0.14	**	0.11 - 0.18
Birth year	0.99	**	0.99 - 0.99	0.99	**	0.98 - 0.99

Notes: p<0.01 **; p<0.05 *; p<0.1 +
Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Table S9. Model 2b, extended, competing-risks survival model, men aged 15-44, 1997-2016, generation by western, non-western origins, cancer among ancestral Swedes as reference.

Model 2b, men	HR	Sig.	95%CIs				HR	Sig.	95%CIs		
Generation by cause						**Generation by cause**					
Cancers						Suicides					
Ancestral Swedes	**1**					Ancestral Swedes	1.50	**	1.43	-	1.57
G1 Western	1.04		0.91	-	1.20	G1 Western	1.04		0.90	-	1.19
G1 Non-Western	0.93		0.82	-	1.06	G1 Non-Western	0.65	**	0.56	-	0.76
G15 Western	1.19	+	0.99	-	1.43	G15 Western	1.95	**	1.68	-	2.26
G15 Non-Western	0.93		0.75	-	1.15	G15 Non-Western	2.18	**	1.88	-	2.51
G2 Western	0.95		0.86	-	1.06	G2 Western	2.14	**	1.98	-	2.30
G2 Non-Western	0.59	**	0.43	-	0.82	G2 Non-Western	1.85	**	1.54	-	2.23
Circulatory diseases						Other external					
Ancestral Swedes	0.79	**	0.75	-	0.83	Ancestral Swedes	0.55	**	0.52	-	0.58
G1 Western	0.90		0.78	-	1.04	G1 Western	0.45	**	0.37	-	0.55
G1 Non-Western	0.65	**	0.55	-	0.75	G1 Non-Western	0.49	**	0.42	-	0.59
G15 Western	1.12		0.92	-	1.35	G15 Western	1.16		0.96	-	1.40
G15 Non-Western	0.57	**	0.43	-	0.75	G15 Non-Western	1.75	**	1.49	-	2.05
G2 Western	0.89	+	0.80	-	1.00	G2 Western	1.02		0.92	-	1.13
G2 Non-Western	0.46	**	0.32	-	0.67	G2 Non-Western	1.55	**	1.26	-	1.90
Other diseases						Ill-defined					
Ancestral Swedes	1.14	**	1.09	-	1.20	Ancestral Swedes	0.19	**	0.17	-	0.20
G1 Western	0.97		0.84	-	1.12	G1 Western	0.69	**	0.59	-	0.82
G1 Non-Western	0.68	**	0.59	-	0.79	G1 Non-Western	0.42	**	0.34	-	0.50
G15 Western	1.84	**	1.58	-	2.14	G15 Western	0.52	**	0.40	-	0.69
G15 Non-Western	1.17		0.96	-	1.42	G15 Non-Western	0.40	**	0.29	-	0.56
G2 Western	1.56	**	1.43	-	1.70	G2 Western	0.35	**	0.29	-	0.41
G2 Non-Western	1.13		0.90	-	1.44	G2 Non-Western	0.57	**	0.41	-	0.80
Accidents											
Ancestral Swedes	1.81	**	1.73	-	1.89						
G1 Western	1.04		0.91	-	1.20						
G1 Non-Western	0.77	**	0.66	-	0.88						
G15 Western	2.73	**	2.41	-	3.09						
G15 Non-Western	2.65	**	2.32	-	3.02						
G2 Western	2.50	**	2.33	-	2.68						
G2 Non-Western	2.52	**	2.15	-	2.96	**Birth year**	0.99	**	0.99	-	0.99

Notes: p<0.01 **; p<0.05 *; p<0.1 +
Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Table S10. Model 2b, extended, competing-risks survival model, women aged 15-44, 1997-2016, generation by western, non-western origins, cancer among ancestral Swedes as reference.

Model 2b, women	HR	Sig.	95%CIs				HR	Sig.	95%CIs		
Generation by cause						**Generation by cause**					
Cancers						Suicides					
Ancestral Swedes	**1**					Ancestral Swedes	0.47	**	0.45	-	0.50
G1 Western	1.05		0.93	-	1.17	G1 Western	0.36	**	0.30	-	0.43
G1 Non-Western	0.97		0.87	-	1.08	G1 Non-Western	0.22	**	0.17	-	0.27
G15 Western	1.19	*	1.00	-	1.40	G15 Western	0.74	**	0.60	-	0.91
G15 Non-Western	0.81	+	0.66	-	1.01	G15 Non-Western	0.93		0.77	-	1.14
G2 Western	1.02		0.93	-	1.12	G2 Western	0.76	**	0.68	-	0.84
G2 Non-Western	0.70	*	0.53	-	0.94	G2 Non-Western	0.79	+	0.60	-	1.04
Circulatory diseases						Other external					
Ancestral Swedes	0.26	**	0.24	-	0.28	Ancestral Swedes	0.15	**	0.14	-	0.17
G1 Western	0.23	**	0.18	-	0.29	G1 Western	0.19	**	0.15	-	0.25
G1 Non-Western	0.19	**	0.15	-	0.24	G1 Non-Western	0.18	**	0.14	-	0.24
G15 Western	0.32	**	0.23	-	0.44	G15 Western	0.21	**	0.14	-	0.31
G15 Non-Western	0.16	**	0.10	-	0.25	G15 Non-Western	0.30	**	0.21	-	0.42
G2 Western	0.27	**	0.23	-	0.33	G2 Western	0.26	**	0.22	-	0.31
G2 Non-Western	0.18	**	0.10	-	0.32	G2 Non-Western	0.18	**	0.10	-	0.32
Other diseases						Ill-defined					
Ancestral Swedes	0.53	**	0.50	-	0.56	Ancestral Swedes	0.06	**	0.05	-	0.07
G1 Western	0.33	**	0.27	-	0.41	G1 Western	0.19	**	0.15	-	0.25
G1 Non-Western	0.41	**	0.35	-	0.48	G1 Non-Western	0.16	**	0.12	-	0.21
G15 Western	0.67	**	0.54	-	0.84	G15 Western	0.11	**	0.06	-	0.19
G15 Non-Western	0.59	**	0.46	-	0.76	G15 Non-Western	0.16	**	0.10	-	0.25
G2 Western	0.62	**	0.55	-	0.70	G2 Western	0.13	**	0.10	-	0.17
G2 Non-Western	0.67	**	0.50	-	0.90	G2 Non-Western	0.21	**	0.12	-	0.35
Accidents											
Ancestral Swedes	0.36	**	0.33	-	0.38						
G1 Western	0.18	**	0.13	-	0.23						
G1 Non-Western	0.14	**	0.10	-	0.18						
G15 Western	0.42	**	0.31	-	0.55						
G15 Non-Western	0.46	**	0.35	-	0.61						
G2 Western	0.50	**	0.44	-	0.56						
G2 Non-Western	0.67	**	0.50	-	0.90	**Birth year**	0.99	**	0.98	-	0.99

Notes: p<0.01 **; p<0.05 *; p<0.1 +
Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Table S11. Model 2c, extended, competing-risks survival model, men aged 15-44, 1997-2016, generation by lowest level origins, cancer among ancestral Swedes as reference.

Model 2c, men	Cancers				Circulatory				Other diseases				Accidents				Suicides				Other external				Ill-defined			
	HR	95%CIs		Sig.	HR	95%CIs		Sig.	HR	95%CIs		Sig.	HR	95%CIs		Sig.	HR	95%CIs		Sig.	HR	95%CIs		Sig.	HR	95%CIs		Sig.
Ancestral Swedes	**1**				0.79	0.75	0.83	**	1.14	1.09	1.20	**	1.81	1.73	1.89	**	1.50	1.43	1.57	**	0.55	0.52	0.58	**	0.19	0.17	0.20	**
Generation 1																												
Finland	1.50	1.02	2.21	*	3.01	2.29	3.96	**	3.82	2.99	4.88	**	2.78	2.09	3.69	**	2.60	1.94	3.50	**	0.81	0.48	1.37		1.39	0.93	2.08	
Other Nordic	0.83	0.53	1.28		0.66	0.41	1.08		0.83	0.53	1.28		1.08	0.73	1.58		1.37	0.97	1.92	+	0.33	0.17	0.66	**	0.74	0.47	1.18	
Other Western	0.77	0.57	1.02	+	0.44	0.30	0.64	**	0.60	0.44	0.83	**	0.67	0.49	0.91	**	0.77	0.57	1.02	+	0.18	0.10	0.32	**	0.44	0.30	0.64	**
Central Eastern Europe	1.18	0.99	1.40	+	0.88	0.72	1.08		0.76	0.61	0.95	**	0.98	0.81	1.18		0.87	0.71	1.07		0.57	0.44	0.73	**	0.72	0.57	0.90	**
The Middle East	0.98	0.83	1.15		0.70	0.58	0.85	**	0.55	0.44	0.68	**	0.79	0.66	0.95	**	0.58	0.47	0.71	**	0.51	0.41	0.64	**	0.36	0.28	0.48	**
Central Southern America	0.82	0.53	1.27		0.45	0.25	0.81	**	0.74	0.46	1.17		0.61	0.37	1.02	+	1.10	0.76	1.61		0.41	0.22	0.76	**	0.41	0.22	0.76	**
Sub-Saharan Africa	1.13	0.86	1.49		0.81	0.59	1.12		1.35	1.05	1.73	*	0.96	0.72	1.29		0.94	0.70	1.27		0.68	0.48	0.97	*	0.73	0.52	1.02	+
Asia	0.65	0.46	0.93	*	0.40	0.26	0.63	**	0.42	0.27	0.65	**	0.57	0.39	0.83	**	0.36	0.22	0.58	**	0.30	0.17	0.50	**	0.27	0.16	0.47	**
Generation 15																												
Finland	1.75	1.33	2.29	**	1.88	1.44	2.44	**	2.96	2.40	3.66	**	3.43	2.82	4.17	**	2.96	2.40	3.66	**	1.75	1.33	2.29	**	0.40	0.22	0.70	**
Other Nordic	0.35	0.13	0.94	*	1.15	0.67	1.98		1.77	1.14	2.74	**	2.47	1.71	3.59	**	1.50	0.93	2.42	+	0.44	0.18	1.06	+	0.44	0.18	1.06	+
Other Western	1.38	0.91	2.10		1.07	0.66	1.72		1.26	0.81	1.95		1.57	1.06	2.33	*	1.51	1.01	2.25	*	0.94	0.57	1.57		0.57	0.29	1.09	+
Central Eastern Europe	0.93	0.67	1.28		0.55	0.36	0.84	**	1.23	0.92	1.63		2.73	2.25	3.30	**	1.48	1.14	1.91	**	1.00	0.73	1.37		0.63	0.42	0.93	*
The Middle East	0.92	0.66	1.28		0.38	0.23	0.64	**	0.87	0.62	1.22		2.66	2.19	3.24	**	1.36	1.03	1.78	*	2.23	1.80	2.76	**	0.46	0.29	0.73	**
Central Southern America	0.90	0.57	1.43		0.65	0.38	1.12		1.40	0.97	2.03	+	2.50	1.89	3.31	**	2.40	1.81	3.20	**	1.25	0.84	1.86		0.15	0.05	0.47	**
Sub-Saharan Africa	0.82	0.41	1.64		0.41	0.15	1.09	+	2.16	1.40	3.31	**	3.49	2.49	4.89	**	2.46	1.65	3.68	**	3.08	2.15	4.41	**	0.92	0.48	1.78	
Asia	0.99	0.65	1.49		0.86	0.55	1.33		1.03	0.69	1.54		2.32	1.77	3.03	**	3.18	2.52	4.00	**	0.77	0.49	1.23		0.30	0.14	0.63	**
Generation 2																												
Finland	0.99	0.85	1.15		1.06	0.91	1.22		1.85	1.65	2.07	**	3.04	2.78	3.34	**	2.58	2.34	2.85	**	1.28	1.12	1.47	**	0.35	0.27	0.45	**
Other Nordic	0.88	0.68	1.13		0.80	0.62	1.05		1.69	1.41	2.04	**	2.02	1.70	2.39	**	2.09	1.77	2.47	**	0.89	0.69	1.15		0.18	0.10	0.31	**
Other Western	1.08	0.89	1.33		0.77	0.61	0.98	*	1.08	0.89	1.33		1.96	1.68	2.28	**	1.63	1.38	1.93	**	0.65	0.50	0.84	**	0.46	0.34	0.62	**
Central Eastern Europe	0.78	0.60	1.01	+	0.73	0.56	0.96	*	1.30	1.06	1.60	**	2.27	1.94	2.66	**	1.69	1.41	2.03	**	0.96	0.75	1.21		0.36	0.24	0.53	**
The Middle East	0.61	0.39	0.95	*	0.52	0.32	0.84	**	1.07	0.77	1.49		2.54	2.04	3.16	**	1.47	1.10	1.95	**	1.77	1.37	2.30	**	0.52	0.32	0.84	**
Central Southern America	0.59	0.28	1.24		0.34	0.13	0.90	*	1.18	0.70	2.00		3.04	2.19	4.22	**	2.02	1.35	3.03	**	1.27	0.76	2.10		0.51	0.23	1.13	
Sub-Saharan Africa	0.47	0.15	1.44		0.62	0.23	1.66		1.40	0.73	2.69		2.48	1.52	4.06	**	2.95	1.88	4.63	**	2.17	1.29	3.67	**	1.09	0.52	2.28	
Asia	0.57	0.27	1.20		0.33	0.12	0.87	*	1.06	0.62	1.83		1.88	1.25	2.83	**	2.04	1.38	3.03	**	0.82	0.44	1.52		0.49	0.22	1.09	+

Notes: p<0.01 **; p<0.05 *; p<0.1 + Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Table S12. Model 2c, extended, competing-risks survival model, women aged 15-44, 1997-2016, , generation by lowest level origins, cancer among ancestral Swedes as reference..

Women	Cancers			Circulatory			Other diseases			Accidents			Suicides			Other external			Ill-defined		
	HR	95%CIs	Sig.	HR	95%CIs	Sig.	HR	95%CIs	Sig.	HR	95%CIs	Sig.	HR	95%CIs	Sig.	HR	95%CIs	Sig.	HR	95%CIs	Sig.
Ancestral Swedes	**1**			0.26	0.24 - 0.28	**	0.53	0.50 - 0.56	**	0.36	0.33 - 0.38	**	0.47	0.45 - 0.50	**	0.15	0.14 - 0.17	**	0.06	0.05 - 0.07	**
Generation 1																					
Finland	1.43	1.10 - 1.86	**	0.54	0.35 - 0.82	**	0.71	0.49 - 1.03	+	0.43	0.27 - 0.70	**	0.69	0.47 - 1.00	*	0.33	0.19 - 0.57	**	0.13	0.05 - 0.31	**
Other Nordic	0.93	0.63 - 1.35		0.34	0.18 - 0.64	**	0.41	0.23 - 0.72	**	0.17	0.07 - 0.41	**	0.45	0.26 - 0.77	**	0.14	0.05 - 0.37	**	0.14	0.05 - 0.37	**
Other Western	0.69	0.50 - 0.96	*	0.13	0.06 - 0.27	**	0.34	0.21 - 0.53	**	0.04	0.01 - 0.15	**	0.24	0.14 - 0.42	**	0.09	0.04 - 0.22	**	0.19	0.10 - 0.35	**
Central Eastern Europe	1.09	0.94 - 1.26		0.17	0.12 - 0.25	**	0.24	0.18 - 0.32	**	0.16	0.11 - 0.23	**	0.31	0.24 - 0.40	**	0.20	0.15 - 0.28	**	0.22	0.16 - 0.30	**
The Middle East	0.95	0.81 - 1.11		0.13	0.09 - 0.20	**	0.21	0.15 - 0.29	**	0.10	0.06 - 0.16	**	0.12	0.08 - 0.19	**	0.20	0.14 - 0.28	**	0.13	0.08 - 0.20	**
Central Southern America	0.88	0.63 - 1.25		0.21	0.11 - 0.43	**	0.24	0.13 - 0.46	**	0.11	0.04 - 0.29	**	0.32	0.18 - 0.57	**	0.08	0.03 - 0.25	**	0.16	0.07 - 0.36	**
Sub-Saharan Africa	1.22	0.96 - 1.55		0.37	0.24 - 0.56	**	1.15	0.90 - 1.47		0.23	0.13 - 0.39	**	0.17	0.09 - 0.32	**	0.26	0.16 - 0.43	**	0.19	0.11 - 0.35	**
Asia	0.88	0.71 - 1.09		0.18	0.11 - 0.29	**	0.37	0.27 - 0.51	**	0.16	0.10 - 0.26	**	0.35	0.25 - 0.49	**	0.16	0.10 - 0.26	**	0.19	0.12 - 0.30	**
Generation 15																					
Finland	1.49	1.16 - 1.92	**	0.47	0.31 - 0.74	**	0.69	0.48 - 0.99	*	0.45	0.29 - 0.71	**	1.00	0.73 - 1.35		0.19	0.09 - 0.38	**	0.05	0.01 - 0.19	**
Other Nordic	1.40	0.90 - 2.18		0.35	0.15 - 0.84	*	0.77	0.43 - 1.40		0.35	0.15 - 0.84	*	0.56	0.28 - 1.12		0.35	0.15 - 0.84	*	0.28	0.11 - 0.75	**
Other Western	1.02	0.65 - 1.60		0.05	0.01 - 0.38	**	0.91	0.56 - 1.46		0.48	0.25 - 0.93	*	0.27	0.11 - 0.64	**	0.11	0.03 - 0.43	**	0.11	0.03 - 0.43	**
Central Eastern Europe	0.89	0.64 - 1.22		0.28	0.16 - 0.49	**	0.51	0.34 - 0.78	**	0.37	0.23 - 0.61	**	0.75	0.53 - 1.06		0.23	0.13 - 0.43	**	0.12	0.05 - 0.28	**
The Middle East	0.64	0.43 - 0.95	*	0.05	0.01 - 0.20	**	0.56	0.37 - 0.86	**	0.46	0.29 - 0.73	**	0.56	0.37 - 0.86	**	0.36	0.21 - 0.61	**	0.10	0.04 - 0.27	**
Central Southern America	0.82	0.51 - 1.31		0.14	0.05 - 0.45	**	0.38	0.19 - 0.77	**	0.53	0.29 - 0.95	*	0.67	0.40 - 1.14		0.29	0.13 - 0.64	**	0.24	0.10 - 0.58	**
Sub-Saharan Africa	1.16	0.66 - 2.05		0.58	0.26 - 1.30		0.87	0.45 - 1.68		0.58	0.26 - 1.30		1.26	0.73 - 2.17		0.19	0.05 - 0.78	*	0.58	0.26 - 1.30	
Asia	0.89	0.63 - 1.25		0.16	0.07 - 0.35	**	0.65	0.44 - 0.97	*	0.39	0.24 - 0.65	**	1.36	1.04 - 1.79	*	0.26	0.14 - 0.49	**	0.05	0.01 - 0.21	**
Generation 2																					
Finland	0.97	0.84 - 1.11		0.32	0.25 - 0.40	**	0.61	0.52 - 0.73	**	0.56	0.47 - 0.67	**	0.96	0.83 - 1.10		0.34	0.27 - 0.42	**	0.13	0.09 - 0.19	**
Other Nordic	1.16	0.95 - 1.41		0.29	0.20 - 0.44	**	0.73	0.57 - 0.94	*	0.42	0.31 - 0.59	**	0.66	0.51 - 0.86	**	0.24	0.15 - 0.37	**	0.09	0.05 - 0.19	**
Other Western	0.96	0.79 - 1.17		0.23	0.16 - 0.34	**	0.57	0.45 - 0.74	**	0.41	0.30 - 0.55	**	0.49	0.37 - 0.64	**	0.17	0.10 - 0.27	**	0.09	0.05 - 0.17	**
Central Eastern Europe	1.07	0.87 - 1.32		0.20	0.12 - 0.32	**	0.60	0.45 - 0.79	**	0.51	0.37 - 0.68	**	0.68	0.53 - 0.88	**	0.19	0.12 - 0.31	**	0.21	0.13 - 0.34	**
The Middle East	0.75	0.51 - 1.11		0.20	0.10 - 0.42	**	0.55	0.35 - 0.86	*	0.92	0.65 - 1.31		0.40	0.24 - 0.68	**	0.20	0.10 - 0.42	**	0.26	0.14 - 0.50	**
Central Southern America	0.48	0.22 - 1.08	+	*No deaths*			0.89	0.49 - 1.60		0.16	0.04 - 0.64	**	0.97	0.55 - 1.70		0.24	0.08 - 0.75	**	0.08	0.01 - 0.57	**
Sub-Saharan Africa	0.27	0.07 - 1.10	+	0.55	0.21 - 1.47		0.69	0.29 - 1.65		0.55	0.21 - 1.47		1.37	0.74 - 2.56		0.14	0.02 - 0.98	*	0.27	0.07 - 1.10	+
Asia	1.00	0.58 - 1.72		0.08	0.01 - 0.55	**	0.77	0.41 - 1.43		0.54	0.26 - 1.13		1.31	0.81 - 2.11		0.08	0.01 - 0.55	**	0.15	0.04 - 0.62	**

Notes: p<0.01 **; p<0.05 *; p<0.1 +

Source: author's calculation based upon the Swedish register data collection "Ageing Well"

Contributions of specific causes of death to overall mortality

The contributions of specific causes to the observed all-cause mortality differentials between migrant-origin populations (i.e., the **G1**, **G15**, and **G2**) can be calculated from Models 2a-c as follows:

$$hr\_c_{zk} = \left(\frac{hr_{zk}(t)}{\sum hr_{zk}(t)} \times \frac{\sum hr_{zk}(t)}{\sum hr_{Zk}(t)}\right) - \left(\frac{hr_{Zk}(t)}{\sum hr_{Zk}(t)}\right)$$

Whereby a lowercase **z** refers to specific groups of migrants and their descendants, while an uppercase $\boldsymbol{Z}$ instead refers to the reference group i.e., the ancestral Swedes. First, divide the hazard ratio **for cause** $\boldsymbol{k}$ for migrant origin group **z** (i.e.., $\boldsymbol{hr_{zk}(t)}$) by the sum of the $\boldsymbol{k}$ cause-specific hazard ratios for migrant-origin group $\boldsymbol{z}$ (i.e., $\sum \boldsymbol{hr_{zk}(t)}$). *NB: the effect of the covariates is additive on this scale.* Next, multiply this value by the value of the sum of the $\boldsymbol{k}$ cause-specific hazard ratios for migrant-origin group $\boldsymbol{z}$ divided by the sum of the $\boldsymbol{k}$ cause-specific hazard ratios for ancestral Swedes (i.e., $\sum \boldsymbol{hr_{Zk}(t)}$). Finally, from this value, subtract the value of the hazard ratio for specific cause $\boldsymbol{k}$ for the ancestral Swedish group (i.e.., $\boldsymbol{hr_{Zk}(t)}$) divided by the sum of all of the $\boldsymbol{k}$ cause-specific hazard ratios for the ancestral Swedes (i.e., $\sum \boldsymbol{hr_{Zk}(t)}$).

Note that $\frac{\sum \boldsymbol{hr_{zk}(t)}}{\sum \boldsymbol{hr_{Zk}(t)}}$ (i.e., the sum of cause-specific hazard ratios from Models 2a-c for migrant-origin group $\boldsymbol{z}$ divided by the sum of the cause-specific hazard ratios for the ancestral Swedes $\boldsymbol{Z}$) generates the all-cause hazard ratio from Models 1a-c for the group for which the calculation is made.

Finally, note that the sum of the contributions of all specific causes of death for a given migrant-origin group + **1** gives the mortality hazard ratio from Models 1a-c for the group for which the calculation is made. One could also replace **1** with $\boldsymbol{hr_{Zk}(t)}$ (i.e., the reference for the ancestral Swedes).

$$hr_z(t) = 1 + \sum hr\_c_{zk}$$

Below, an example is provided from Model 2a for men belonging to the **G15**. We can follow with Table 1.

Table 1. Calculating hazard ratio contributions for the G15, men

Generation	Cause of death	(a)	(b)	(c)	(d)
Ancestral Swedes (AS)	Cancer	1.00	0.14	-	-
	Circulatory	0.79	0.11	-	-
	Other diseases	1.14	0.16	-	-
	Accidents	1.81	0.26	-	-
	Suicides	1.50	0.21	-	-
	Other external	0.55	0.08	-	-
	Ill-defined	0.19	0.03		-
Sum of HRs		**6.97**		**1.00**	**-**
G15	Cancer	1.07	0.11	0.15	0.01
	Circulatory	0.85	0.08	0.12	0.01
	Other diseases	1.52	0.15	0.22	0.05
	Accidents	2.69	0.27	0.39	0.13
	Suicides	2.06	0.20	0.30	0.08
	Other external	1.45	0.14	0.21	0.13
	Ill-defined	0.47	0.05	0.07	0.04
Sum of HRs		**10.10**		**1.45**	**0.45**
Ratio vs. ancestral Swedes		**1.45**		**1.45**	**-**

$$hr\_c_{G15\_accidents} = \left(\frac{2.69}{10.10} \times \frac{10.10}{6.97}\right) - \left(\frac{1.81}{6.97}\right) = +0.13$$

The values in column a are taken directly from Model 2a. Let us calculate the contribution for accident mortality. **G15** men have a hazard ratio from accident mortality of 2.69 in Model 2a. We first divide 2.69 by the sum of all of the cause-specific mortality hazard ratios for **G15** men (10.10) to give a value of 0.27 (column b). Next, we multiply this value of 0.27 by 1.45 (i.e., the sum of all of the cause-specific **G15** hazard ratios [10.10] divided by the sum of all of the cause-specific hazard ratios for ancestral Swedish men [6.97]) to give a value of 0.39 (column

c). One could alternatively, just use the all-cause hazard ratio for the **G15** from Model 1a. Finally, from this value of 0.39 we can subtract the value for accidents in ancestral Swedes (0.26) to give a +0.13 contribution (column d) of accidents among **G15** men to their all-cause hazard ratio vs. ancestral Swedes. 1 + the sum of the respective contributions of each cause, as column d shows would then equates to the all-cause mortality hazard ratio from Model 1a (HR 1.45).

Stockholm Research Reports in Demography
Stockholm University,
106 91 Stockholm,
Sweden
www.su.se | info@su.se | ISSN 2002-617X

Stockholm University

Demography Unit