Differences in mortality between groups of older migrants and older non-migrants in Belgium, 2001-09

Reus-Pons, Matias; Vandenheede, Hadewijch; Janssen, Fanny; Kibele, Eva U. B.

Published in:
European Journal of Public Health

DOI:
10.1093/eurpub/ckw076

Publication date:
2016

The European Journal of Public Health, Vol. 26, No. 6, 992–1000

doi:10.1093/eurpub/ckw076 Advance Access published on 16 June 2016

Differences in mortality between groups of older migrants and older non-migrants in Belgium, 2001–09

Matias Reus-Pons[1,2], Hadewijch Vandenheede[2], Fanny Janssen[1,3], Eva U.B. Kibele[1,4]

1 Population Research Centre (PRC), Faculty of Spatial Sciences, University of Groningen, Groningen, The Netherlands
2 Interface Demography, Department of Sociology, Vrije Universiteit Brussel, Brussels, Belgium
3 Netherlands Interdisciplinary Demographic Institute (NIDI), The Hague, The Netherlands
4 Healthy Ageing Population and Society (HAPS), University of Groningen, Groningen, The Netherlands

Correspondence: Matias Reus Pons, Faculty of Spatial Sciences, P.O. Box 800, 9700, AV Groningen, The Netherlands, Tel: +31 (0) 503635601, e-mail: m.reus.pons@rug.nl

Background: European societies are rapidly ageing and becoming multicultural. We studied differences in overall and cause-specific mortality between migrants and non-migrants in Belgium specifically focusing on the older population. **Methods:** We performed a mortality follow-up until 2009 of the population aged 50 and over living in Flanders and the Brussels-Capital Region by linking the 2001 census data with the population and mortality registers. Overall mortality differences were analysed via directly age-standardized mortality rates. Cause-specific mortality differences between non-migrants and various western and non-western migrant groups were analysed using Poisson regression models, controlling for age (model 1) and additionally controlling for socio-economic status and urban typology (model 2). **Results:** At older ages, most migrants had an overall mortality advantage relative to non-migrants, regardless of a lower socio-economic status. Specific migrant groups (e.g. Turkish migrants, French and eastern European male migrants and German female migrants) had an overall mortality disadvantage, which was, at least partially, attributable to a lower socio-economic status. Despite the general overall mortality advantage, migrants experienced higher mortality from infectious diseases, diabetes-related causes, respiratory diseases (western migrants), cardiovascular diseases (non-western female migrants) and lung cancer (western female migrants). **Conclusion:** Mortality differences between older migrants and non-migrants depend on cause of death, age, sex, migrant origin and socio-economic status. These differences can be related to lifestyle, social networks and health care use. Policies aimed at reducing mortality inequalities between older migrants and non-migrants should address the specific health needs of the various migrant groups, as well as socio-economic disparities.

Introduction

The study of mortality differences between older migrants and non-migrants in Europe is important for a number of reasons. Health is a universal human right, irrespective of nationality or migrant status.[1] Accordingly, the European Parliament encourages EU member states to tackle health inequalities, including those between migrants and non-migrants.[2] This becomes even more relevant in a context where European societies are becoming older and more multicultural.[3]

Previous studies on all-cause mortality differences between migrants and non-migrants mainly focused on the total or younger adult population. These studies found that migrants in Europe often have an overall mortality advantage relative to non-migrants, despite generally having a lower socio-economic status, which is known as the 'migrant mortality paradox'.[4–6]

However, relative mortality differences between migrants and non-migrants vary by country of residence, migrant origin, sex and age.[7] Since non-migrants' mortality differs across countries,[8] relative mortality inequalities cannot be strictly compared. However, similar relative positioning may indicate 'country of origin' effects. While in France most migrant groups had a mortality advantage over non-migrants,[9] in England and Wales most migrant groups experienced higher mortality than non-migrants.[10] In the Netherlands, mortality was higher among most male migrant groups compared with non-migrants, while differences were not statistically significant among females.[11] In Belgium, adults from southern Europe, Morocco and Turkey had lower mortality risks than non-migrants, while French males and sub-Saharan females experienced higher risks.[12] Compared with the non-migrant population, most migrant groups in France and the Netherlands were reported to have higher mortality at younger ages, but lower mortality at older ages.[9,11,13]

Previous studies showed that the overall mortality advantage of migrants could only be partially explained by positive health selection—i.e. the fact that predominantly young and healthy people migrate.[4,5,13] Furthermore, this selection effect wears off with length of stay.[14] Negative health selection—i.e. the return of unhealthy migrants to their country of origin—appears to be an unlikely explanation in Europe.[4,5,14] Therefore, mortality differences between older migrants and non-migrants must be attributable to other mechanisms, such as health-related lifestyles,[15] social and migrant networks[16] and health care use,[17] which often change in a migration context.[18] The analysis of cause-specific mortality differences enables to disentangle some of these mechanisms via specific risk profiles related to specific causes of death.

Previous studies on relative cause-specific mortality differences showed that most migrants, especially those of non-western origin, had excess mortality from infectious diseases, diabetes and homicide; and low mortality from all cancers combined.[9–12,14,19] Cardiovascular and cerebrovascular disease mortality tends to be high among migrants from eastern Europe, South Asia, the Caribbean and sub-Saharan Africa and low among migrants from Morocco and Turkey.[9–12]

To our knowledge, no study so far analysed relative cause-specific mortality differences between migrants and non-migrants specifically focusing on the older population. Our aim is therefore to analyse overall and cause-specific mortality differences between different groups of older migrants and non-migrants.

We performed our analysis in Belgium, one of the forerunners in Europe in the transition to an older and more multicultural society. Furthermore, Belgium currently has a larger proportion of older migrants than other traditional European immigration countries, such as Germany, the UK and the Netherlands.[16]

Methods

We studied first-generation migrants and non-migrants aged 50 years and older living in Flanders and the Brussels-Capital Region at the time of the 2001 census. We performed a mortality follow-up of these individuals until 2009. The final population included in the analyses was 2 356 122, of whom 92.3% were non-migrants and 7.7% were migrants.

We defined migrants as individuals born outside Belgium and with a foreign nationality at birth. We classified migrants according to their nationality at birth into two main groups: western and non-western.[14] We additionally distinguished more specific migrant groups, including the main nationalities of older migrants in Belgium (Dutch, French, German, Moroccan and Turkish migrants), southern European migrants (grouped together since most of them had arrived as 'guest workers'[16]) and eastern European migrants (grouped together since most of them were political refugees or belonged to ethnic minorities[20]). Second-generation migrants ($N = 20\,936$) were excluded, since their mortality outcomes likely differ from both those of non-migrants and those of first-generation migrants.

Data on age, sex, nationality at birth, education, housing status and urban typology were derived from the 2001 census. Census data were linked with the population and mortality register data in two steps. First, the census was linked with population register data on emigration and all-cause mortality via a personal ID number (100% linkage). Censored cases consisted of people who left Flanders and the Brussels-Capital Region during the follow-up period. Information on the cause of death was then obtained by linking these data with the mortality register using an identification key (98% of the cases linked).

The classification of the underlying causes of death and the respective ICD-10 codes included in each category are shown in table A (online supplement). This classification takes into account the most important causes of death at older ages, the potential risk factors and ensures comparability with classifications from previous studies.[12,14]

All of the analyses were performed separately by sex.

We analysed overall mortality differences via direct age-standardized mortality rates (ASMR) and their 95% confidence intervals (CI)[21] over the period 2001–09 for the different groups of older migrants and non-migrants, considering the total older population in Flanders and the Brussels-Capital Region in 2001 as the standard.

The analysis of cause-specific mortality differences required us to weight our data. While it was possible to link the census and register data with the mortality register data for 98% of the population, the proportion of unlinked cases was considerably higher for some migrant groups (table B, online supplement). We calculated simple ratio weights[22] based on sex, age, nationality at birth, education and urban typology for those who died during the interval. We calculated ASMR for the different causes of death to assess the contribution of each cause of death to the overall ASMR of the different groups of older migrants and non-migrants.

Relative mortality differences over the study period were analysed using weighted Poisson regression models for each cause of death. From these models, we derived mortality rate ratios (MRRs) and their 95% CI, for the different groups of older migrants relative to older non-migrants. The natural logarithm of the person-years at risk was included in the models as the offset variable. Model 1 controls for age, whereas model 2 additionally controls for socio-economic status (education and housing status) and urban typology. For this purpose only, we additionally considered the associated and intermediate causes of death for alcohol- and diabetes-attributable mortality, since the effects of alcohol on health are often underestimated at older ages[23] and diabetes is often associated with mortality without being the underlying cause.[24]

Age was defined as a categorical variable in five-year age groups up to 85+. Education consisted of four categories (up to primary, lower secondary, upper secondary and tertiary education). Housing status was defined as a compound variable including both housing quality and tenure.[24] Urban typology distinguished between central cities, suburbs and non-urban municipalities.[25] The unweighted regression results are available in tables C and D (online supplement).

Results

The ASMR of older non-migrants were 31.4 deaths per 1000 (95% CI 31.3–31.6) for males and 27.7 deaths per 1000 (27.6–27.8) for females (table 1). Migrants, especially those of non-western origin, tended to have lower mortality than non-migrants. Mortality was particularly low among Moroccan males (ASMR 23.0, 95% CI 21.5–24.5) and females (23.8, 21.4–26.1). In contrast, mortality was especially high among French males (34.5, 32.8–36.2) and German females (32.4, 30.8–33.9).

Except for Dutch male migrants and German female migrants, the age-specific mortality rates of migrants were lower or higher than those of non-migrants depending on age. The overall mortality advantage (disadvantage) of most western migrants reflected lower (higher) age-specific mortality rates at 'younger' older ages. Most non-western migrants and southern European migrants also experienced lower age-specific mortality rates than non-migrants among the oldest old.

Cancers and cardiovascular diseases made up about two-thirds of all-cause mortality among all groups (figure 1). The proportion of mortality due to respiratory diseases was especially high among southern European male migrants (ca. 20%). The contributions to overall mortality of infectious diseases, diabetes mellitus, external causes of death, alcohol-related causes and symptoms, signs and ill-defined conditions were small among all groups.

Older migrants tended to experience an all-cause mortality advantage relative to non-migrants (tables 2 and 3). Below, we discuss the results for model 2 (controlling for age, socio-economic status and urban typology), while considering changes with respect to model 1 (controlling for age only).

Controlling for socio-economic status and urban typology diminished the MRR for most causes of death and origin groups, often increasing migrants' mortality advantage. The overall mortality disadvantage of some specific migrant groups was explained by socio-economic status, and even reversed in the case of Turkish male migrants (MRR 0.876, 95% CI 0.817–0.938). After controlling for socio-economic status, the MMR remained high only among German female migrants (1.131, 1.078–1.186).

Among older males, mortality due to cancers, cardiovascular diseases and external causes of death tended to be lower among migrants, especially those of non-western origin, than among non-migrants. Male migrants, especially those of non-western origin, had higher mortality due to infectious diseases and diabetes-related causes. Diabetes-related mortality was especially high, with a MRR above 1.5, among southern European and non-western male migrants, even after controlling for socio-economic status. Mortality due to respiratory diseases tended to be lower among non-western migrants, but higher among western migrants, especially among southern (1.218, 1.120–1.324) and eastern European male migrants (1.156, 1.024–1.305). Alcohol-related mortality was particularly high among French male migrants (1.339, 1.072–1.673). Suicide (0.179, 0.107–0.299) and alcohol-

Table 1 Age-standardized mortality rates (ASMR) using the total population as the standard, number of deaths and person-years at risk of migrants and non-migrants aged 50+ over the period 2001–09 (Flanders and Brussels-Capital Region)

Origin group	Males				Females			
	ASMR per 1000	Deaths	Person-years at risk		ASMR per 1000	Deaths	Person-years at risk	
	(95% CI)		Number	%	(95% CI)		Number	%
Total population	31.3 [31.2–31.4]	243 739	7 787 938	100.00	27.7 [27.6–27.8]	259 385	9 363 546	100.00
Non-migrants	31.4 [31.3–31.6]	229 509	7 165 459	92.01	27.7 [27.6–27.8]	245 006	8 693 845	92.85
Migrants	29.5 [29.0–30.0]	14 230	622 479	7.99	27.2 [26.7–27.6]	14 379	669 701	7.15
Western	30.3 [29.7–30.8]	11 061	424 727	5.45	27.4 [26.9–27.8]	12 531	505 875	5.40
German	30.8 [28.4–33.2]	634	26 452	0.34	32.4 [30.8–33.9]	1 683	56 097	0.60
French	34.5 [32.8–36.1]	1 647	56 402	0.72	28.1 [27.0–29.2]	2 418	78 746	0.84
Dutch	27.6 [26.7–28.6]	3 067	122 882	1.58	27.0 [26.1–28.0]	3 029	134 735	1.44
Southern European[a]	30.7 [29.6–31.8]	3 076	136 031	1.75	24.3 [23.2–25.4]	2 143	132 091	1.41
Eastern European[b]	33.9 [32.2–35.6]	1 564	39 257	0.50	28.8 [27.5–30.1]	2 133	58 093	0.62
Other western	27.7 [26.0–29.5]	1 073	43 704	0.56	25.5 [24.0–27.1]	1 125	46 113	0.49
Non-western	24.6 [23.5–25.6]	3 169	197 751	2.54	23.4 [22.0–24.7]	1 848	163 826	1.75
Turkish	31.4 [28.5–34.3]	816	41 283	0.53	27.4 [24.6–30.3]	547	39 544	0.42
Moroccan	23.0 [21.6–24.5]	1 560	98 856	1.27	23.8 [21.4–26.1]	784	74 066	0.79
Other non-western	22.7 [21.0–24.5]	793	57 613	0.74	20.4 [18.4–22.4]	517	50 215	0.54

Data source: Belgian 2001 census linked to National Register (2001–09).

a: Southern European includes migrants from Portugal, Spain, Italy, Malta, Greece and Cyprus.

b: Eastern European includes migrants from Poland, Hungary, Romania, Bulgaria, Albania, former Czechoslovakia, former Yugoslavia and former USSR.

related mortality (0.179, 0.132–0.243) were very low among non-western male migrants. Finally, in line with the general trend, mortality due to symptoms, signs and ill-defined conditions and mortality due to other causes of death tended to be lower among male migrants.

The cause-specific mortality differences by migrant origin among older females followed a similar pattern than those of older males. However, some important differences should be noted, especially regarding cancer and cardiovascular disease. Even after adjusting for socio-economic status, overall cancer mortality tended to be higher among female western migrants, mainly due to a large mortality disadvantage in lung cancer mortality (1.233, 1.122–1.355). Similarly, even after controlling for socio-economic status, overall cardiovascular disease mortality was higher among German (1.121, 1.036–1.214) and non-western female migrants, especially among females of Turkish origin (1.463, 1.291–1.658); this pattern was also visible when we examined mortality due to ischaemic heart disease and cerebrovascular disease. Suicide (1.843, 1.223–2.778) was very high among French female migrants.

Discussion

At older ages, both western and non-western migrants had an all-cause mortality advantage relative to non-migrants, despite generally having a lower socio-economic status. However, migrants had higher mortality from infectious diseases, diabetes-related causes, respiratory diseases (western migrants), cardiovascular diseases (non-western female migrants) and lung cancer (western female migrants).

Explanation of the observed results

The overall mortality advantage of most migrant groups was mainly due to lower mortality risks for most causes of death, especially cancer and cardiovascular disease. Older migrants' mortality advantages in chronic diseases may be explained by a number of factors. Migrants, especially those of non-western origin, tend to have a healthier lifestyle, including a healthier diet,[26] and lower levels of alcohol and tobacco consumption.[15] Even though migrants may adopt unhealthy behaviours from the host society, chronic conditions often have long latency periods[27,28] and are related to life-long cumulative risk behaviours.[29] Furthermore, migrant networks and families may help migrants cope with the challenges involved in migration,[16] which could be protective against the negative effects of low socio-economic status on mortality. The exceptionally low levels of mortality due to suicide, alcohol-related causes and lung cancer (females only) among Turkish and Moroccan migrants are likely attributable to health-related behaviours shaped by cultural and religious factors.[12]

However, we also found that migrants had mortality disadvantages for specific diseases. Older migrants, especially those of non-western origin (including Moroccans and Turks), had higher mortality than non-migrants from infectious diseases and diabetes-related causes, which is in line with previous results focusing on people aged 25–54.[12,14] The excess mortality from infectious diseases among non-western migrants at the time of migration may reflect the mortality pattern in the regions of origin.[28] However, at older ages, this could be the result of higher levels of deprivation[12] and less use of preventive health services.[17] Although both diabetes-related and cardiovascular disease mortalities are associated with obesity, the risk of diabetes-related mortality seems to increase shortly after the adoption of obesity-related behaviours, while cardiovascular diseases often have long latency periods.[14] The higher respiratory disease mortality risk observed among southern European male migrants could be related to the fact that many of them worked in heavy metal and mining industries.[30]

Among females, non-western migrants had higher levels of cardiovascular disease mortality, and western migrants (except southern Europeans) had higher levels of lung cancer mortality, as compared with non-migrants. These patterns of mortality disadvantage were not found among males. The high cardiovascular mortality risk of non-western female migrants (including Moroccan and Turks) may be partly attributable to their lower mortality risk from other chronic diseases. However, obesity, one of the risk factors for cardiovascular disease,[31] is highly prevalent among non-western female migrants, both in their countries of origin[32] and in Europe.[12,33] Lung cancer mortality is highly associated with smoking.[34] Although the contribution of lung cancer mortality to all-cause mortality among western female migrants was small, smoking rates among females are expected to increase further.[35]

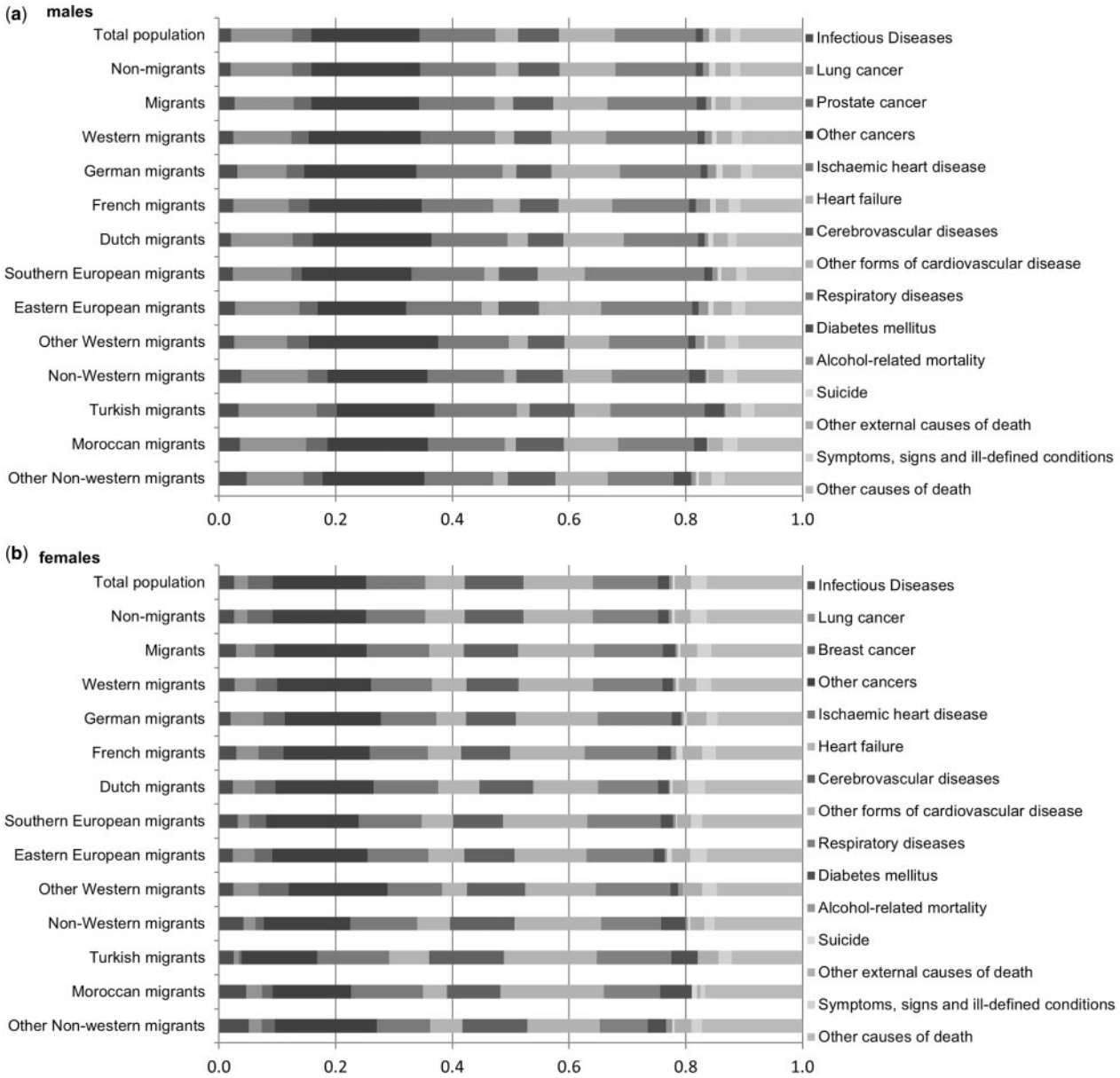

Figure 1 Contribution of the different causes of death to the age-standardized mortality rate at ages 50 and over by sex over the period 2001–09, according to migrant origin (Flanders and Brussels-Capital Region). Data source: Belgian 2001 census linked to National Register (2001–09). In this figure, mortality due to alcohol and diabetes mellitus refers only to the underlying cause of death. Southern European includes migrants from Portugal, Spain, Italy, Malta, Greece and Cyprus. Eastern European includes migrants from Poland, Hungary, Romania, Bulgaria, Albania, former Czechoslovakia, former Yugoslavia and former USSR

In line with previous studies on mortality differences between migrants and non-migrants in Belgium at ages 25–54[12,14] and 10–29,[36] our study shows that older migrants tend to have a mortality advantage over non-migrants, many years after migration (75% of older migrants have been living in Belgium for more than 20 years). Whereas among the younger population mortality differences by migrant origin were to a large extent determined by external and alcohol-related causes, mortality differences at older ages were mainly attributable to chronic diseases. The cardiovascular mortality disadvantage among non-western female migrants and the lung cancer mortality disadvantage among western female migrants were only visible at older ages, possibly due to the difference in time between the adoption of risk profiles and their effects on mortality.[28]

Migrants often have a lower socio-economic status than non-migrants, and socio-economic status is inversely associated with mortality.[4–6] Our study confirms this association, as controlling for socio-economic status tended to increase migrants' mortality advantage. For specific causes of death or among specific origin groups, migrants' mortality disadvantages were, at least partially, attributable to socio-economic status. For instance, higher mortality risks due to alcohol-related causes and suicide among French migrants were largely explained by socio-economic status; French migrants in Belgium originate mostly from poorer regions in France, and tend to reside in more deprived neighbourhoods.[12]

Evaluation of data and methods

Despite using high quality census and register data, some methodological issues warrant attention. First of all, given that the age-specific mortality rates of migrants cross over with those of non-migrants, the choice of a 'younger' or an 'older' standard

Table 2 Cause-specific mortality rate ratios with 95% confidence intervals for male migrants compared with non-migrants (reference) aged 50+ over the period 2001–09 (Flanders and Brussels-Capital Region), including the number of deaths by cause (*N*)

Origin group	All-cause mortality[a,b] *N*=243 739		Cancer (all)[a,b] *N*=76 945	
	Model 1	Model 2	Model 1	Model 2
Western	**0.958 [0.940–0.976]**	**0.906 [0.889–0.924]**	**0.948 [0.917–0.980]**	**0.906 [0.876–0.937]**
German	0.996 [0.921–1.076]	0.987 [0.913–1.067]	0.927 [0.809–1.062]	0.924 [0.807–1.059]
French	**1.098 [1.046–1.152]**	1.008 [0.960–1.058]	**1.096 [1.006–1.193]**	1.017 [0.934–1.107]
Dutch	**0.873 [0.843–0.905]**	**0.910 [0.878–0.943]**	**0.927 [0.873–0.985]**	0.965 [0.909–1.026]
Southern European[c]	**0.964 [0.930–0.999]**	**0.825 [0.796–0.855]**	**0.911 [0.857–0.968]**	**0.797 [0.750–0.848]**
Eastern European[d]	**1.057 [1.006–1.111]**	0.979 [0.932–1.029]	0.954 [0.867–1.050]	**0.894 [0.812–0.984]**
Non-western	**0.854 [0.825–0.885]**	**0.697 [0.673–0.722]**	**0.790 [0.745–0.837]**	**0.666 [0.628–0.707]**
Turkish	**1.082 [1.010–1.159]**	**0.876 [0.817–0.938]**	1.022 [0.913–1.143]	**0.853 [0.762–0.955]**
Moroccan	**0.815 [0.775–0.857]**	**0.643 [0.611–0.676]**	**0.766 [0.706–0.832]**	**0.625 [0.575–0.679]**
Origin group	**Lung cancer[a,b] *N* =24 986**		**Prostate cancer[a,b] *N*=7958**	
	Model 1	Model 2	Model 1	Model 2
Western	**0.910 [0.858–0.966]**	**0.870 [0.819–0.923]**	**0.862 [0.771–0.964]**	**0.834 [0.746–0.934]**
German	**0.765 [0.592–0.989]**	0.790 [0.611–1.021]	1.048 [0.681–1.614]	1.025 [0.666–1.579]
French	1.016 [0.870–1.185]	0.928 [0.795–1.084]	1.085 [0.827–1.423]	1.037 [0.791–1.361]
Dutch	**0.875 [0.785–0.975]**	0.951 [0.853–1.060]	0.912 [0.752–1.105]	0.923 [0.761–1.119]
Southern European[c]	0.928 [0.837–1.029]	**0.774 [0.697–0.859]**	**0.552 [0.422–0.721]**	**0.512 [0.391–0.670]**
Eastern European[d]	1.064 [0.905–1.252]	1.006 [0.854–1.184]	1.012 [0.771–1.329]	0.959 [0.730–1.260]
Non-western	**0.880 [0.802–0.967]**	**0.699 [0.636–0.770]**	**0.793 [0.638–0.986]**	**0.719 [0.577–0.896]**
Turkish	**1.239 [1.044–1.470]**	0.949 [0.799–1.127]	0.906 [0.577–1.423]	0.823 [0.524–1.295]
Moroccan	**0.877 [0.771–0.998]**	**0.661 [0.580–0.753]**	0.798 [0.592–1.077]	**0.711 [0.526–0.962]**
Origin group	**Cardiovascular diseases (all)[a,b] *N*=80 037**		**Ischaemic heart disease[a,b] *N*=31 088**	
	Model 1	Model 2	Model 1	Model 2
Western	**0.910 [0.879–0.941]**	**0.877 [0.848–0.908]**	**0.939 [0.890–0.990]**	**0.910 [0.862–0.960]**
German	1.079 [0.945–1.231]	1.085 [0.950–1.238]	1.179 [0.967–1.438]	1.198 [0.983–1.461]
French	1.049 [0.963–1.144]	0.983 [0.902–1.071]	1.024 [0.891–1.177]	0.957 [0.833–1.100]
Dutch	**0.860 [0.808–0.915]**	**0.893 [0.839–0.950]**	**0.876 [0.793–0.966]**	0.918 [0.831–1.013]
Southern European[c]	**0.856 [0.801–0.916]**	**0.757 [0.707–0.810]**	0.926 [0.837–1.024]	**0.821 [0.742–0.908]**
Eastern European[d]	1.040 [0.955–1.133]	0.990 [0.909–1.079]	1.069 [0.932–1.227]	1.025 [0.893–1.176]
Non-western	**0.884 [0.830–0.942]**	**0.748 [0.702–0.797]**	0.915 [0.833–1.006]	**0.776 [0.705–0.853]**
Turkish	**1.151 [1.019–1.300]**	0.960 [0.849–1.085]	**1.328 [1.118–1.578]**	1.103 [0.928–1.311]
Moroccan	**0.847 [0.775–0.926]**	**0.695 [0.636–0.760]**	0.876 [0.766–1.001]	**0.719 [0.628–0.823]**
Origin group	**Heart failure[a,b] *N*=9341**		**Cerebrovascular disease[a,b] *N*=16 620**	
	Model 1	Model 2	Model 1	Model 2
Western	**0.793 [0.712–0.883]**	**0.794 [0.712–0.885]**	**0.891 [0.825–0.961]**	**0.871 [0.807–0.941]**
German	0.596 [0.341–1.041]	0.624 [0.357–1.091]	0.883 [0.637–1.223]	0.897 [0.647–1.243]
French	1.255 [0.995–1.581]	1.234 [0.979–1.555]	1.014 [0.836–1.230]	0.973 [0.802–1.180]
Dutch	**0.767 [0.632–0.931]**	**0.795 [0.655–0.965]**	**0.771 [0.667–0.891]**	**0.794 [0.687–0.918]**
Southern European[c]	**0.638 [0.497–0.818]**	**0.593 [0.462–0.762]**	0.919 [0.795–1.062]	**0.839 [0.725–0.971]**
Eastern European[d]	0.808 [0.617–1.057]	0.813 [0.621–1.065]	1.021 [0.847–1.231]	0.995 [0.824–1.200]
Non-western	**0.614 [0.473–0.796]**	**0.556 [0.428–0.722]**	1.093 [0.960–1.243]	0.962 [0.844–1.097]
Turkish	0.866 [0.524–1.432]	0.763 [0.461–1.262]	1.297 [0.997–1.688]	1.125 [0.864–1.465]
Moroccan	**0.525 [0.353–0.781]**	**0.461 [0.309–0.687]**	1.050 [0.874–1.260]	0.906 [0.753–1.089]
Origin group	**Infectious diseases[a,b] *N*=4898**		**Respiratory diseases[a,b] *N*=33 130**	
	Model 1	Model 2	Model 1	Model 2
Western	**1.149 [1.015–1.301]**	1.024 [0.903–1.161]	**1.093 [1.040–1.148]**	1.045 [0.994–1.098]
German	1.489 [0.942–2.354]	1.404 [0.888–2.220]	0.986 [0.790–1.231]	1.023 [0.819–1.278]
French	1.311 [0.958–1.795]	1.135 [0.829–1.555]	1.068 [0.934–1.222]	0.989 [0.864–1.131]
Dutch	0.851 [0.660–1.099]	0.883 [0.683–1.140]	**0.800 [0.723–0.885]**	**0.866 [0.783–0.959]**
Southern European[c]	1.217 [0.968–1.528]	0.956 [0.759–1.203]	**1.482 [1.365–1.610]**	**1.218 [1.120–1.324]**
Eastern European[d]	**1.393 [1.030–1.884]**	1.177 [0.869–1.594]	**1.232 [1.092–1.389]**	**1.156 [1.024–1.305]**
Non-western	**1.667 [1.384–2.009]**	**1.222 [1.010–1.478]**	**0.864 [0.778–0.960]**	**0.663 [0.596–0.737]**
Turkish	1.234 [0.767–1.987]	0.921 [0.571–1.484]	**1.247 [1.025–1.517]**	0.932 [0.766–1.135]
Moroccan	**1.569 [1.203–2.047]**	1.108 [0.846–1.451]	**0.807 [0.694–0.940]**	**0.590 [0.506–0.687]**

(continued)

Table 2 Continued

Origin group	Diabetes-related causes[a,b] *N*=11 849		Alcohol-related causes[a,b] *N*=5241	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Western	**1.152 [1.064–1.248]**	1.025 [0.945–1.111]	1.027 [0.915–1.153]	**0.766 [0.681–0.861]**
German	0.830 [0.564–1.223]	0.793 [0.538–1.168]	1.280 [0.857–1.912]	0.991 [0.663–1.481]
French	**1.372 [1.124–1.673]**	1.170 [0.959–1.428]	**2.028 [1.625–2.531]**	**1.339 [1.072–1.673]**
Dutch	**0.695 [0.580–0.833]**	**0.733 [0.611–0.879]**	**0.559 [0.421–0.742]**	**0.562 [0.423–0.746]**
Southern European[c]	**1.727 [1.530–1.950]**	**1.336 [1.181–1.510]**	**0.766 [0.608–0.965]**	**0.501 [0.397–0.632]**
Eastern European[d]	**1.322 [1.079–1.620]**	1.123 [0.915–1.377]	**1.653 [1.233–2.215]**	1.104 [0.823–1.481]
Non-western	**2.038 [1.835–2.263]**	**1.441 [1.294–1.605]**	**0.302 [0.223–0.409]**	**0.179 [0.132–0.243]**
Turkish	**2.481 [2.018–3.052]**	**1.782 [1.447–2.195]**	**0.241 [0.115–0.506]**	**0.156 [0.074–0.327]**
Moroccan	**1.980 [1.712–2.291]**	**1.358 [1.171–1.576]**	**0.136 [0.072–0.257]**	**0.079 [0.042–0.150]**
Origin group	**External causes of death (all)[a,b] *N*=8567**		**Suicide[a,b] *N*=2560**	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Western	**0.890 [0.804–0.984]**	**0.813 [0.734–0.900]**	**0.705 [0.578–0.859]**	**0.649 [0.531–0.792]**
German	1.120 [0.778–1.614]	1.070 [0.743–1.542]	1.128 [0.606–2.103]	1.089 [0.584–2.031]
French	1.000 [0.775–1.291]	0.864 [0.670–1.116]	0.953 [0.602–1.506]	0.827 [0.522–1.309]
Dutch	**0.796 [0.658–0.964]**	0.836 [0.690–1.013]	**0.651 [0.447–0.947]**	**0.682 [0.468–0.994]**
Southern European[c]	**0.803 [0.662–0.974]**	**0.654 [0.538–0.795]**	**0.603 [0.414–0.880]**	**0.498 [0.340–0.728]**
Eastern European[d]	1.154 [0.893–1.491]	1.017 [0.786–1.316]	0.801 [0.448–1.430]	0.727 [0.406–1.301]
Non-western	**0.602 [0.496–0.732]**	**0.464 [0.381–0.565]**	**0.229 [0.137–0.382]**	**0.179 [0.107–0.299]**
Turkish	**0.640 [0.423–0.968]**	**0.492 [0.325–0.746]**	**0.159 [0.042–0.609]**	**0.122 [0.032–0.465]**
Moroccan	**0.630 [0.482–0.823]**	**0.466 [0.356–0.611]**	**0.162 [0.068–0.382]**	**0.121 [0.051–0.287]**
Origin group	**Symptoms, signs and ill-defined conditions[a,b] *N*=4134**		**Other causes of death[a,b] *N*=25 432**	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Western	0.996 [0.863–1.148]	**0.846 [0.732–0.977]**	**0.929 [0.875–0.986]**	**0.864 [0.813–0.918]**
German	0.832 [0.429–1.613]	0.748 [0.385–1.451]	0.787 [0.595–1.040]	0.757 [0.573–1.001]
French	1.322 [0.947–1.846]	1.073 [0.768–1.499]	1.118 [0.964–1.297]	1.020 [0.879–1.183]
Dutch	0.787 [0.592–1.045]	0.822 [0.619–1.093]	0.920 [0.826–1.024]	0.935 [0.839–1.041]
Southern European[c]	0.952 [0.719–1.261]	**0.677 [0.510–0.899]**	0.892 [0.792–1.004]	**0.758 [0.672–0.854]**
Eastern European[d]	1.281 [0.914–1.796]	1.020 [0.727–1.431]	0.971 [0.832–1.134]	0.871 [0.746–1.018]
Non-western	1.008 [0.781–1.301]	**0.648 [0.500–0.839]**	**0.869 [0.773–0.977]**	**0.711 [0.632–0.800]**
Turkish	0.776 [0.407–1.478]	**0.517 [0.271–0.985]**	0.971 [0.760–1.242]	0.798 [0.624–1.021]
Moroccan	1.093 [0.775–1.541]	**0.669 [0.473–0.946]**	**0.819 [0.693–0.968]**	**0.651 [0.550–0.771]**

Data source: Belgian 2001 census linked to National Register (2001–09).
a: Model 1: Controlling for age; Model 2: Controlling for age, education, housing status and urban typology.
b: In bold, statistically significant ($P < 0.05$).
c: Southern European includes migrants from Portugal, Spain, Italy, Malta, Greece and Cyprus.
d: Eastern European includes migrants from Poland, Hungary, Romania, Bulgaria, Albania, former Czechoslovakia, former Yugoslavia and former USSR.

population can affect the comparability of ASMR. We performed a sensitivity analysis with the WHO World Standard Population 2000–25 as the standard; the comparison of the ASMR of migrants and non-migrants led to the same conclusions.

Because the cause of death was unknown for more than 20% of non-western migrants who died during the follow-up period, we ran weighted Poisson regression models. Weighted results can be regarded as more accurate than unweighted results, which are artificially lowered, especially in the case of non-western migrants. However, when using ratio weights based on a large number of strata, there is a chance that weights cannot be defined for certain unlinked cases.[22] Stratifying the deceased by age, sex, nationality at birth, education and urban typology of the area of residence reduced undefined weights to only 36 cases (less than 0.5% in every migrant origin group, results not shown), and hence to a minor fraction of the population-based data.

Even when controlling for socio-economic status, a residual effect of socio-economic status on mortality could remain unexplained, as migrants may be in a more deprived situation than non-migrants in a similar socio-economic position.[37] We believe that this effect was minimized, as we controlled for two different dimensions of socio-economic status,[38] which reflected both the current socio-economic status (housing quality) and the socio-economic status during childhood and youth (education).[39]

Finally, due to data limitations, we excluded from our study people living in the Walloon Region. Although the population of Wallonia tend to have worse mortality outcomes than the population of Flanders,[40] historic patterns of migration are similar throughout Belgium.[16] Furthermore, the patterns in the mortality differences between older migrants and non-migrants found in our study are largely in line with those found in earlier studies for the entire Belgian population aged 25–54.[12,14] Therefore, the results of our study can be regarded as generalizable to the whole country.

Overall conclusion

Mortality differences between older migrants and non-migrants are highly dependent on cause of death, age, sex, origin and socio-

Table 3 Cause-specific mortality rate ratios with 95% confidence intervals for female migrants compared with non-migrants (reference) aged 50+ over the period 2001–09 (Flanders and Brussels-Capital Region), including the number of deaths by cause (*N*)

Origin group	All-cause mortality[a,b] *N*=259 385		Cancer (all)[a,b] *N*=57 472	
	Model 1	Model 2	Model 1	Model 2
Western	0.989 [0.971–1.007]	**0.948 [0.931–0.965]**	1.016 [0.979–1.053]	**0.963 [0.928–0.999]**
German	**1.183 [1.127–1.241]**	**1.131 [1.078–1.186]**	**1.322 [1.206–1.449]**	**1.261 [1.151–1.383]**
French	1.008 [0.968–1.049]	**0.950 [0.912–0.989]**	1.021 [0.937–1.113]	0.954 [0.875–1.039]
Dutch	0.970 [0.936–1.006]	0.974 [0.939–1.009]	1.016 [0.946–1.091]	1.016 [0.946–1.091]
Southern European[c]	**0.894 [0.856–0.933]**	**0.806 [0.772–0.841]**	**0.809 [0.744–0.880]**	**0.728 [0.669–0.792]**
Eastern European[d]	1.014 [0.972–1.058]	0.977 [0.936–1.019]	1.071 [0.976–1.175]	1.004 [0.915–1.102]
Non-western	**0.943 [0.901–0.987]**	**0.826 [0.789–0.865]**	**0.702 [0.642–0.769]**	**0.617 [0.564–0.676]**
Turkish	**1.109 [1.020–1.206]**	0.971 [0.893–1.056]	**0.642 [0.531–0.775]**	**0.570 [0.472–0.689]**
Moroccan	0.957 [0.892–1.026]	**0.805 [0.750–0.864]**	**0.702 [0.614–0.803]**	**0.600 [0.524–0.686]**
Origin group	**Lung cancer[a,b] *N*=6020**		**Breast cancer[a,b] *N*=10 795**	
	Model 1	Model 2	Model 1	Model 2
Western	**1.521 [1.386–1.670]**	**1.233 [1.122–1.355]**	**0.826 [0.754–0.906]**	**0.792 [0.722–0.869]**
German	**2.763 [2.270–3.362]**	**2.339 [1.921–2.847]**	1.033 [0.816–1.308]	0.990 [0.781–1.254]
French	**1.696 [1.372–2.097]**	**1.308 [1.057–1.619]**	0.998 [0.816–1.220]	0.942 [0.770–1.152]
Dutch	**1.511 [1.265–1.804]**	**1.519 [1.271–1.815]**	**0.789 [0.658–0.945]**	**0.782 [0.653–0.937]**
Southern European[c]	**0.732 [0.566–0.947]**	**0.496 [0.383–0.643]**	**0.617 [0.499–0.762]**	**0.584 [0.472–0.722]**
Eastern European[d]	**1.734 [1.364–2.204]**	**1.328 [1.044–1.690]**	**0.752 [0.579–0.976]**	**0.710 [0.546–0.921]**
Non-western	**0.540 [0.407–0.717]**	**0.347 [0.261–0.462]**	**0.354 [0.271–0.462]**	**0.332 [0.254–0.434]**
Turkish	**0.383 [0.195–0.753]**	**0.257 [0.131–0.506]**	**0.166 [0.076–0.363]**	**0.159 [0.073–0.347]**
Moroccan	**0.568 [0.377–0.854]**	**0.332 [0.220–0.501]**	**0.321 [0.212–0.486]**	**0.299 [0.197–0.454]**
Origin group	**Cardiovascular diseases (all)[a,b] *N*=98 990**		**Ischaemic heart disease[a,b] *N*=25 844**	
	Model 1	Model 2	Model 1	Model 2
Western	0.972 [0.944–1.001]	**0.961 [0.933–0.990]**	1.018 [0.963–1.077]	1.006 [0.951–1.064]
German	**1.145 [1.058–1.240]**	**1.121 [1.036–1.214]**	1.097 [0.938–1.282]	1.077 [0.921–1.259]
French	0.960 [0.900–1.025]	**0.934 [0.874–0.997]**	0.993 [0.876–1.127]	0.958 [0.844–1.087]
Dutch	0.969 [0.914–1.027]	0.979 [0.923–1.038]	1.057 [0.948–1.179]	1.083 [0.971–1.207]
Southern European[c]	**0.931 [0.868–0.999]**	**0.882 [0.822–0.946]**	0.980 [0.861–1.116]	0.912 [0.801–1.040]
Eastern European[d]	0.978 [0.914–1.047]	0.981 [0.916–1.050]	1.050 [0.922–1.196]	1.049 [0.920–1.195]
Non-western	**1.166 [1.083–1.255]**	**1.086 [1.008–1.170]**	**1.282 [1.124–1.461]**	**1.155 [1.012–1.319]**
Turkish	**1.583 [1.397–1.793]**	**1.463 [1.291–1.658]**	**1.633 [1.298–2.055]**	**1.448 [1.150–1.823]**
Moroccan	**1.206 [1.076–1.352]**	1.080 [0.963–1.212]	**1.553 [1.290–1.869]**	**1.335 [1.108–1.608]**
Origin group	**Heart failure[a,b] *N*=17 168**		**Cerebrovascular disease[a,b] *N*=25 575**	
	Model 1	Model 2	Model 1	Model 2
Western	**0.874 [0.811–0.942]**	**0.914 [0.848–0.985]**	**0.884 [0.832–0.938]**	**0.885 [0.833–0.940]**
German	0.937 [0.754–1.166]	0.956 [0.769–1.189]	1.046 [0.890–1.228]	1.036 [0.882–1.218]
French	0.862 [0.731–1.017]	0.886 [0.751–1.045]	**0.848 [0.740–0.972]**	**0.840 [0.733–0.963]**
Dutch	1.034 [0.902–1.186]	1.049 [0.914–1.203]	0.906 [0.805–1.019]	0.910 [0.808–1.024]
Southern European[c]	**0.744 [0.608–0.911]**	**0.772 [0.631–0.946]**	**0.807 [0.698–0.935]**	**0.786 [0.679–0.911]**
Eastern European[d]	0.900 [0.762–1.064]	0.973 [0.823–1.150]	**0.850 [0.737–0.982]**	**0.865 [0.749–0.999]**
Non-western	0.841 [0.663–1.067]	0.896 [0.705–1.138]	**1.235 [1.075–1.420]**	**1.197 [1.040–1.376]**
Turkish	1.207 [0.820–1.778]	1.266 [0.860–1.866]	**1.791 [1.426–2.251]**	**1.713 [1.363–2.153]**
Moroccan	0.773 [0.512–1.166]	0.798 [0.528–1.205]	1.077 [0.852–1.361]	1.017 [0.804–1.286]
Origin group	**Infectious diseases[a,b] *N*=6586**		**Respiratory diseases[a,b] *N*=28 468**	
	Model 1	Model 2	Model 1	Model 2
Western	1.034 [0.927–1.154]	0.965 [0.864–1.078]	**1.061 [1.007–1.119]**	0.993 [0.942–1.048]
German	0.908 [0.647–1.275]	0.847 [0.603–1.189]	**1.331 [1.159–1.528]**	**1.239 [1.079–1.423]**
French	1.184 [0.941–1.491]	1.082 [0.859–1.363]	**1.139 [1.018–1.275]**	1.040 [0.929–1.164]
Dutch	0.897 [0.710–1.133]	0.903 [0.715–1.141]	0.915 [0.818–1.023]	0.919 [0.822–1.029]
Southern European[c]	1.191 [0.944–1.503]	1.020 [0.807–1.288]	1.006 [0.886–1.141]	**0.857 [0.755–0.974]**
Eastern European[d]	0.984 [0.753–1.287]	0.919 [0.702–1.202]	1.076 [0.952–1.215]	1.015 [0.898–1.147]
Non-western	**1.827 [1.475–2.264]**	**1.499 [1.207–1.862]**	0.977 [0.841–1.135]	**0.799 [0.687–0.929]**
Turkish	**1.581 [1.004–2.488]**	1.317 [0.836–2.076]	**1.304 [1.010–1.683]**	1.077 [0.834–1.391]
Moroccan	**2.160 [1.593–2.928]**	**1.687 [1.242–2.293]**	1.074 [0.857–1.345]	0.824 [0.657–1.033]

(continued)

Table 3 Continued

Origin group	Diabetes-related causes[a,b] *N*=16 269		Alcohol-related causes[a,b] *N*=2461	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Western	**1.082 [1.010–1.159]**	**1.077 [1.005–1.154]**	0.936 [0.784–1.118]	**0.759 [0.634–0.909]**
German	1.127 [0.930–1.367]	1.116 [0.920–1.353]	1.059 [0.651–1.722]	0.887 [0.545–1.444]
French	0.987 [0.841–1.159]	0.950 [0.809–1.116]	**1.748 [1.266–2.413]**	1.312 [0.949–1.813]
Dutch	0.947 [0.819–1.096]	0.986 [0.852–1.140]	0.675 [0.453–1.005]	0.673 [0.452–1.001]
Southern European[c]	**1.604 [1.412–1.821]**	**1.472 [1.294–1.674]**	0.669 [0.447–1.002]	**0.485 [0.323–0.728]**
Eastern European[d]	1.080 [0.917–1.272]	1.104 [0.937–1.301]	0.807 [0.467–1.397]	0.604 [0.349–1.046]
Non–western	**2.280 [2.017–2.578]**	**1.972 [1.741–2.234]**	**0.586 [0.395–0.868]**	**0.394 [0.265–0.585]**
Turkish	**2.828 [2.275–3.515]**	**2.375 [1.909–2.955]**	**0.359 [0.130–0.987]**	**0.258 [0.094–0.711]**
Moroccan	**2.676 [2.247–3.187]**	**2.177 [1.824–2.597]**	**0.406 [0.202–0.817]**	**0.262 [0.130–0.528]**
Origin group	**External causes of death (all)[a,b] *N*=8199**		**Suicide[a,b] *N*=1271**	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Western	1.040 [0.944–1.145]	0.950 [0.862–1.048]	0.991 [0.781–1.259]	0.885 [0.695–1.127]
German	**1.471 [1.160–1.867]**	**1.356 [1.069–1.721]**	1.411 [0.780–2.551]	1.305 [0.721–2.361]
French	**1.392 [1.149–1.687]**	**1.238 [1.021–1.502]**	**2.157 [1.435–3.241]**	**1.843 [1.223–2.778]**
Dutch	0.879 [0.716–1.079]	0.887 [0.722–1.089]	0.751 [0.448–1.260]	0.769 [0.458–1.291]
Southern European[c]	**0.693 [0.537–0.895]**	**0.583 [0.451–0.753]**	**0.400 [0.197–0.814]**	**0.324 [0.159–0.660]**
Eastern European[d]	1.148 [0.913–1.443]	1.028 [0.817–1.293]	1.691 [0.987–2.897]	1.425 [0.830–2.447]
Non-western	**0.662 [0.506–0.865]**	**0.534 [0.408–0.699]**	**0.505 [0.289–0.882]**	**0.390 [0.222–0.684]**
Turkish	0.955 [0.611–1.492]	0.789 [0.505–1.234]	No cases	No cases
Moroccan	**0.437 [0.265–0.721]**	**0.337 [0.204–0.556]**	0.591 [0.276–1.267]	**0.436 [0.202–0.940]**
Origin group	**Symptoms, signs and ill-defined conditions[a,b] *N*=7071**		**Other causes of death[a,b] *N*= 41 627**	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Western	0.901 [0.803–1.010]	**0.843 [0.751–0.946]**	**0.949 [0.906–0.993]**	**0.891 [0.851–0.932]**
German	0.920 [0.652–1.298]	0.849 [0.602–1.198]	1.011 [0.889–1.151]	0.945 [0.830–1.075]
French	0.866 [0.669–1.122]	0.795 [0.613–1.030]	0.916 [0.826–1.015]	**0.845 [0.762–0.937]**
Dutch	1.039 [0.841–1.283]	1.026 [0.831–1.268]	0.986 [0.902–1.077]	0.983 [0.899–1.074]
Southern European[c]	**0.648 [0.467–0.899]**	**0.569 [0.410–0.790]**	0.924 [0.830–1.029]	**0.806 [0.723–0.898]**
Eastern European[d]	1.006 [0.783–1.292]	0.942 [0.733–1.210]	0.986 [0.888–1.094]	0.928 [0.836–1.031]
Non-western	**0.441 [0.276–0.703]**	**0.381 [0.239–0.609]**	**0.857 [0.752–0.977]**	**0.732 [0.642–0.834]**
Turkish	0.813 [0.415–1.590]	0.722 [0.369–1.413]	0.886 [0.687–1.142]	**0.767 [0.595–0.989]**
Moroccan	**0.258 [0.097–0.687]**	**0.212 [0.080–0.566]**	0.856 [0.696–1.051]	**0.698 [0.568–0.858]**

Data source: Belgian 2001 census linked to National Register (2001–09).

a: Model 1: Controlling for age; Model 2: Controlling for age, education, housing status and urban typology.

b: In bold, statistically significant ($P < 0.05$).

c: Southern European includes migrants from Portugal, Spain, Italy, Malta, Greece and Cyprus.

d: Eastern European includes migrants from Poland, Hungary, Romania, Bulgaria, Albania, former Czechoslovakia, former Yugoslavia and former USSR.

economic status. Despite generally having a lower socio-economic position, the tendencies of migrants to have healthier diets, and lower levels of alcohol and tobacco consumption, and strong family and migrant networks might explain the overall migrant mortality advantage over non-migrants. However, lower use of preventive services and higher rates of obesity and smoking may explain the mortality disadvantages of specific migrant groups in some causes of death, some of which arose only at older ages.

As Belgium is among the first of the European countries to make the transition to being an older and more multicultural society, the results of our study are relevant for policies in Belgium and in other countries facing similar challenges. Policies aimed at reducing mortality inequalities between migrants and non-migrants should address the specific health needs of various groups based on country or region of origin, socio-economic status and age.

Acknowledgements

All authors received public funding either from the University of Groningen or the Vrije Universiteit Brussel. We would like to express our gratitude to the Flemish Agency for Care and Health for supplying the cause-specific mortality data, to Hannelore De Grande (Interface Demography, Vrije Universiteit Brussel) for performing the linkage procedure, to Didier Willaert (Interface Demography, Vrije Universiteit Brussel) for his indispensable data support and to Mark van Duijn (Faculty of Spatial Sciences, University of Groningen) for his support and guidance with the weighting procedure.

Supplementary data

Supplementary data are available at *EURPUB* online.

Conflicts of interest: None declared.

Key points

- We assessed both the overall and the cause-specific mortality differences between different migrants groups and non-migrants specifically focusing on the older population.
- In Belgium, migrants maintained an overall mortality advantage relative to non-migrants at older ages.
- However, migrants had higher mortality from infectious diseases, and diabetes-related causes than non-migrants. Unlike younger migrants, some older migrants also experienced higher mortality from lung cancer and cardio-vascular disease.
- Controlling for socio-economic status increased the overall migrants' mortality advantage even further, and partially explained migrants' mortality disadvantage for specific causes.

References

1 International Organization for Migration. *International Migration, Health and Human Rights*. Geneva: International Organization for Migration, 2013.

2 European Union. European Parliament resolution of 8 March 2011 on reducing health inequalities in the EU (2010/2089(INI)). *Off J Eur Union* 2012;55:25–36.

3 Lanzieri G. *Fewer, Older and Multicultural?: Projections of the EU Populations by Foreign/National Background*. Luxembourg: Eurostat, 2011.

4 Razum O, Zeeb H, Akgün HS, Yilmaz S. Low overall mortality of Turkish residents in Germany persists and extends into a second generation: merely a healthy migrant effect? *Trop Med Int Health* 1998;3:297–303.

5 Abraído-Lanza AF, Dohrenwend BP, Ng-Mak DS, Turner JB. The latino mortality paradox: a test of the ''salmon bias'' and healthy migrant hypotheses. *Am J Public Health* 1999;89:1543–8.

6 Palloni A, Arias E. Paradox lost: explaining the Hispanic adult mortality advantage. *Demography* 2004;41:385–415.

7 Agyemang C, de-Graft AA, Bhopal R. Ethnicity and cardiovascular health research: pushing the boundaries by including comparison populations in the countries of origin. *Ethn Health* 2012;17:579–96.

8 Bhopal RS, Rafnsson SB, Agyemang C, et al. Mortality from circulatory diseases by specific country of birth across six European countries: test of concept. *Eur J Public Health* 2012;22:353–9.

9 Boulogne R, Jougla E, Breem Y, et al. Mortality differences between the foreign-born and locally-born population in France (2004–2007). *Soc Sci Med* 2012;74:1213–23.

10 Landman J, Cruickshank JK. A review of ethnicity, health and nutrition-related diseases in relation to migration in the United Kingdom. *Public Health Nutr* 2001;4:647–57.

11 Bos V, Kunst AE, Keij-Deerenberg IM, et al. Ethnic inequalities in age- and cause-specific mortality in the Netherlands. *Int J Epidemiol* 2004;33:1112–9.

12 Deboosere P, Gadeyne S. Adult migrant mortality advantage in Belgium: evidence using census and register data. *Population (English Edition)* 2005;60:655–98.

13 Uitenbroek DG, Verhoeff AP. Life expectancy and mortality differences between migrant groups living in Amsterdam, the Netherlands. *Soc Sci Med* 2002;54:1379–88.

14 Vandenheede H, Willaert D, De Grande H, et al. Mortality in adult immigrants in the 2000s in Belgium: a test of the 'healthy-migrant' and the 'migration-as-rapid-health-transition' hypotheses. *Trop Med Int Health* 2015;20:1832–45.

15 Abraído-Lanza AF, Chao MT, Flórez KR. Do healthy behaviors decline with greater acculturation?: Implications for the Latino mortality paradox. *Soc Sci Med* 2005;61:1243–55.

16 De Valk HAG, Huisman C, Noam KR. *Migration Patterns and Immigrants Characteristics in North-Western Europe*. The Hague: Netherlands Interdisciplinary Demographic Institute, 2011. Report for CELADE/UN regional office.

17 Nørredam M, Krasnik A. Migrants' access to health services. In: Rechel B, Mladovsky P, Devillé W, et al. editors. *Migration and Health in the European Union.* Berkshire: Open University Press, 2011: 67–80.

18 Marmot MG, Adelstein AM, Bulusu L. Lessons from the study of immigrant mortality. *Lancet* 1984;1:1455–7.

19 Singh GK, Siahpush M. All-cause and cause-specific mortality of immigrants and native born in the United States. *Am J Public Health* 2001;91:392–9.

20 Jennissen R, Van der Gaag N, Van Wissen L. Searching for similar international migration trends across countries in Europe. *Genus* 2006;62:37–64.

21 Curtin LR, Klein RJ. Direct standardization (age-adjusted death rates). *Healthy People 2000 Stat Notes* 1995;6:1–10.

22 Fawcett J, Blakely T, Atkinson J. *Weighting the 81, 86, 91 & 96 census-mortality cohorts to adjust for linkage bias.* Wellington: Department of Public Health, Wellington School of Medicine and Health Sciences, 2002. NZCMS Technical Report No.: 5.

23 Hoeck S, Van Hal G. Unhealthy drinking in the Belgian elderly population: prevalence and associated characteristics. *Eur J Public Health* 2012;23:1069–75.

24 Vandenheede H, Vanroelen C, Gadeyne S, et al. Household-based socioeconomic position and diabetes-related mortality among married and cohabiting persons: findings from a census-based cohort study (Flanders, 2001-2010). *J Epidemiol Community Health* 2013;67:765–71.

25 Luyten S, Van Hecke E. *De Belgische stadsgewesten 2001* [The Belgian Urban Regions 2001]. Brussels: Direction for Statistics and Economic Information, 2007. Statistics Belgium working paper No.: 14.

26 Darmon N, Khlat M. An overview of the health status of migrants in France, in relation to their dietary practices. *Public Health Nutr* 2001;4:163–72.

27 Law M, Wald N. Why heart disease mortality is low in France: the time lag explanation. *BMJ* 1999;318:1471–80.

28 Razum O, Twardella D. Time travel with Oliver Twist–Towards an explanation for a paradoxically low mortality among recent immigrants. *Trop Med Int Health* 2002;7:4–10.

29 Reinikainen J, Laatikainen T, Karvanen J, Tolonen H. Lifetime cumulative risk factors predict cardiovascular disease mortality in a 50-year follow-up study in Finland. *Int J Epidemiol* 2015;44:108–16.

30 Phalet K, Swyngedouw M. Measuring immigrant integration: the case of Belgium. *Migrat Stud* 2003;40:773–803.

31 Flegal KM, Graubard BI, Williamson DF, Gail MH. Cause-specific excess deaths associated with underweight, overweight, and obesity. *JAMA* 2007;298:2028–37.

32 Martorell R, Khan LK, Hughes ML, Grummer-Strawn LM. Obesity in women from developing countries. *Eur J Clin Nutr* 2000;54:247–52.

33 Agyemang C, Addo J, Bhopal R, et al. Cardiovascular disease, diabetes and established risk factors among populations of sub-Saharan African descent in Europe: a literature review. *Global Health* 2009;5:7.

34 Peto R, Lopez AD, Boreham J, et al. Mortality from tobacco in developed countries: indirect estimation from national vital statistics. *Lancet* 1992;339:1268–78.

35 Janssen F, Spriensma AS. The contribution of smoking to regional mortality differences in the Netherlands. *Demogr Res* 2012;9:233–60.

36 De Grande H Vandenheede H. Cause-specific mortality among young adults in Belgium: Differences according to nationality of origin. Paper presented at: *European Population Conference*; 25–28 June 2014; Budapest (Hungary).

37 Nazroo JY. Genetic, cultural or socio-economic vulnerability? Explaining ethnic inequalities in health. *Sociol Health Ill* 1998;20:710–30.

38 Adler NE, Boyce T, Chesney MA, et al. Socioeconomic status and health: the challenge of the gradient. *Am Psychol* 1994;49:15–24.

39 Bhopal R, Hayes L, White M, et al. Ethnic and socio-economic inequalities in coronary heart disease, diabetes and risk factors in Europeans and South Asians. *J Public Health Med* 2002;24:95–105.

40 Van Oyen H, Tafforeau J, Roelands M. Regional inequities in health expectancy in Belgium. *Soc Sci Med* 1996;43:1673–8.

The European Journal of Public Health, Vol. 26, No. 6, 1001–1006

doi:10.1093/eurpub/ckw084 Advance Access published on 1 July 2016

Ethnic differences in sleep duration at 5 years, and its relationship with overweight and blood pressure

Kenneth O. Anujuo[1], Tanja G.M. Vrijkotte[1], Karien Stronks[1], Girardin Jean-Louis[2], Charles O. Agyemang[1]

1 Department of Public Health, Academic Medical Center, University of Amsterdam, Amsterdam, The Netherlands
2 Department of Medicine, Center for Healthful Behavior Change, Division of General Internal Medicine, New York University School of Medicine, New York, USA

Correspondence: Kenneth O. Anujuo, Department of Public Health, Academic Medical Center, University of Amsterdam, Meibergdreef 9, 1105 AZ Amsterdam, The Netherlands, Tel: +31 20 5664885, Fax: +31 206972316, e-mail: k.o.anujuo@amc.uva.nl

Background: Studies on adult population indicate shorter sleep duration in ethnic minority groups than host populations. We examined ethnic differences in sleep duration and its relationship with overweight and blood pressure (BP) among children living in Amsterdam. **Methods**: Participants include 2384 children (aged 5 years) and their mothers from the Amsterdam-based longitudinal study. Sleep was categorised into short sleep (<10 h/night) and normal sleep (10–11 h/night). Linear regressions (β) were used to study association between sleep duration and systolic BP (SBP) and diastolic BP (DBP). Prevalence ratios (PRs) were used to study ethnic differences in sleep duration and its association with overweight and raised BP. **Results**: Minority groups reported shorter sleep duration compared to native Dutch, with prevalence ranging from 11.3% in Dutch to 53.1% in Ghanaians. Age-adjusted PRs ranged from 3.38 (95%CI 2.63–4.34) in Moroccans to 4.78 (95%CI 3.36–6.82) in Ghanaian compared with Dutch children. Increased prevalence of overweight was observed among children with short sleep in Dutch and Moroccans only, but this risk was no longer statistically significant after further adjustment for socioeconomic status. Short sleep was not related to SBP and DBP in all groups. No relationship was observed between short sleep and raised BP except for African Surinamese (3.65, 95% CI 1.23–10.8). **Conclusion**: Like adults, children from ethnic minority populations sleep less hours than Dutch children. Efforts to improve ethnic inequalities in sleep hygiene should also include children at younger age. Associations as reported in adults with overweight and BP could not consistently be replicated in children, however.

Introduction

A wide range of studies on sleep duration among adults from various ethnic minority groups have been conducted in many countries with results showing that ethnic minority groups have short sleep duration compared to their host populations.[1–3] Studies on sleep duration among children of various ethnic groups show mixed results, however. For instance, it has been reported that ethnic minority children (African American, Asian, Native American, Hispanic and biracial) sleep less than nonminority children (White or European American),[4] whereas, Biggs *et al.*[5] reported there was no significant difference in sleep duration between Southeast Asian and Europeans in a study conducted in Australia. Another cross-country comparative study,[6,7] alongside other studies, indicated that children from Asia have shorter sleep duration than their American and European counterparts.[8–15] A recent study in Netherlands showed that migrant children sleep less than their Dutch counterparts.[16] Unfortunately, this study did not clearly take into account the children with African background (such as African Surinamese and Ghanaians), and did not explore the association of sleep with blood pressure (BP) among the ethnic groups probably due to lack of data.

Sleep duration may contribute to increase in the prevalence of chronic health conditions in both children and adult populations.[17–19] Previous studies have shown that short sleep duration was independently associated with increased overweight/obesity in children and adolescents.[20–23] A recent study also indicated that short sleep duration was associated with overweight and obesity in migrant children, compared with European Dutch.[24] However, this study did not clearly explore observations among children with African background such as the African Surinamese and Ghanaians. Studies in children have demonstrated that sleep duration was related to BP, but these studies also show inconsistent results, e.g. whereas some studies reported that short sleep duration was related to high BP,[25] another study found that short and long sleep durations were related with high BP.[19] However, one study found no significance difference in the relationship between sleep duration and BP.[26]

The purpose of this study was to examine self-reported sleep duration among 5 years old children in a multi-ethnic population in the Netherlands, using the Amsterdam Born Child and their Development study (ABCD), a Dutch-population-based study. In addition, we assessed the relationship between sleep duration and overweight, and BP among these children.

Study population and methods

Study population

The main goal of the ABCD study is to examine and determine factors in early life (during pregnancy and infancy) that might explain the later health of the child with specific attention paid to ethnic inequalities. Approval was obtained from the Academic Medical Center Medical Ethical Committee, the Vrije Universiteit Medical Center Medical Committee and the Registration Committee of Amsterdam. All participating mothers gave written informed consent for themselves and their children.

The design and rationale of the ABCD study have been described previously.[27] In brief, between January 2003 and March 2004, 8266 pregnant women were included in the study after their first antenatal visit to an obstetric caregiver (phase 1). Of these respondents, 7863 women gave birth to a viable singleton infant and 6575 women gave