Adult Migrant Mortality Advantage in Belgium: using census and register data to document different explanatory hypotheses.

Patrick Deboosere,
Sylvie Gadeyne,
Interface Demography
Vrije Universiteit Brussel

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1. Introduction

There is a consistent finding, supported by many studies, that lower socio-economic status is related to higher mortality and morbidity. This has also been extensively documented for Belgium (Gadeyne & Deboosere, 2002; Bossuyt e.a., 2004). In this regard, the observed lower mortality level among adults of some Mediterranean migrant communities in Belgium is especially striking given their general lower socio-economic status. Lower mortality among adult migrants has been widely reported for other countries (Razum et al., 1998; Courbage & Khlat, 1996; Kouris-Blazos, 2003; Palloni & Arias, 2003). This finding has been conceived by many demographers and epidemiologists as a paradox (the "Hispanic paradox, the "Latino paradox" or the "Greek paradox").

Low levels of mortality in migrant communities are often accompanied by health problems associated with social deprivation. This observation led to the conclusion that low mortality levels have nothing to do with a better health among migrants, but are artefacts due to selection processes or spurious relationships (Weitoft et al., 1999). However, in recent years several studies refuted the hypothesis that reduced mortality in some migrant communities is a statistical artefact. Abraido-Lanza et al. (1999) rejected the explanation of "salmon bias"[1] and the "healthy migrant" selection effect. In a study on life expectancy of migrant groups living in Amsterdam, Uitenbroek and Verhoef (2002) conclude that with regard to their data it seems likely that some migrant groups do have high life expectancy, although the morbidity in these groups can be quite high. They suggest that many health problems associated with detrimental working and living conditions can be seriously disabling without being life-threatening.

[1] Salmon bias refers to a salmon-like tendency to return in old age to one's place of birth.

Excluding the importance of statistical artefacts as the main explaining factor of lower mortality, many researchers were looking for lower risk factors in life style and diet or on the psychological level ("the migrant hope effect"). In a few cases biological predisposition has also been proved to be a factor of influence.

As better life expectancy is the result of lower mortality for some specific causes, several studies focused on this aspect. Differences have been reported for a number of causes such as cancers (Rosenwaike, 1990; Bouchardy e.a., 1995; Muir, 1996), heart diseases (Razum, 1998; Sundquist and Johansson, 1997) or suicide (Hjern and Allebeck, 2002). Cause specific mortality patterns are undoubtedly the most powerful tool to unlock the mystery of the paradox. Abraido-Lanzo et al. (1999) conclude that a systematic test examining different causes of death is needed to control the hypothesis that cultural factors contribute to Latino health.

Belgium is well suited to further explore these major explanations thanks to the presence of large migrant communities, making up more than 10 percent of the population, and the existence of a national population register. The present analysis looks into new data to give a detailed description of cause specific mortality patterns for the largest migrant communities: Italian, Spanish, Moroccan and Turk, compared to Belgian native population. But before making comparisons between national groups, the plausibility of selection mechanisms explaining the lower mortality of migrant populations is explored using information stemming from the confrontation of population registers and death certificates.

Belgium has a long history of migration and migrant settlement. As a small country and active trading centre with a geographically open and central location, the country has been a natural passageway and place of settlement of many migrants. Traditionally national state boarders were not so clear cut for populations living on either side of the boarders. So there have always been important "migrant" communities from neighbouring countries residing in Belgium, and many Belgians settled in those neighbouring countries. To this day, many Germans, French and Dutch live in Belgium, as do many Belgians in the neighbouring countries. In terms of socio-economic status those populations are quite similar to the Belgian.
Today's migrant population started taking form in the interbellum when labour demand of the heavy industry and the coal mines attracted the first Italian labour migrants. Migration from Spain took off in the same period and was accelerated by the Spanish civil war. Immediately after the Second World War labour migration rose sharply, with tens of thousands of mainly Italian workers recruited for the Belgian mines. Later on, as the post-war economic boom was spread over Europe, new cheap labour force was recruited from Turkey and Morocco. This massive labour migration ended abruptly with the economic crisis of the early seventies. Migration since then has been restricted to family reunion and the import of brides and grooms by the Moroccan and Turkish populations. Meanwhile, a new cycle of migration started with an important influx of political refugees. Finally, with the historical colonial ties of Belgium with black Africa, a small black African community has also been formed over time.

2. Data and methods

2.1. The National Population Register and the '91 Census

The Belgian National Population Register is fully operational since 1988. It is a centralised register covering the whole of the country. The register keeps track of the population residing in Belgium and all the important demographic transitions: birth, death, migration, change in civil state, etc. This yields a unique situation allowing analysts to follow demographic events on a very vast and detailed scale and to combine different demographic events on an individual level.
It doesn't mean, however, that the register has no flaws or that every person residing in Belgium is actually registered. Illegal immigration is by definition not registered and registration is limited to what people want to be known administratively. But apart from illegal immigrants, errors are marginal. Moreover, besides the compulsory character of the registration, people have also a lot of incentives to register correctly. Pension funds, social security, unemployment benefits, are all based on an inscription in the national register.

The analysis is based on data from the 1991 Belgian census, linked to registration records of all deaths and emigrations between the 1st of March 1991 and the 1st January 1996. Total Belgian population on the date of the census amounted to 9.978.681 persons. Thanks to Statistics Belgium a direct individual link has been established with register data.
The data set avoids the classical numerator denominator problem trough the direct link established at the individual level. The link with the national population register guarantees that essential information as exact date of birth, nationality, nationality at birth, date of arrival in Belgium, date of registration in the population register and eventual dates of emigration or death are very accurate. Covariates such as educational level, house ownership or level of domestic comfort are based on the census form.
The current study was limited to adults aged 25-54 at the time of census covering a total of 4.140.559 persons.

It is important to underline the implications of working with register data.

1. We are working with the administrative reality. The population involved in the analysis was registered in the municipality on the date of the 1991 census. Illegal residents are not included in the analysis. We know that illegal residents are probably more likely to be in bad health, but our prime interest is in morbidity and mortality differences between officially registered migrants and the native Belgium population. For our research question the only relevant aspect is related to the selection hypothesis which has to be reformulated in order to take into account the possible selection effect of being included or not in the register.

2. The population analysed is semi-closed: nobody can enter the population. People can leave the population by emigration or death. Emigration is not always registered: some persons quit Belgium to return to their country of origin or to another foreign

country without notifying their departure. This is rather rare for those who have been part of the labour force. Everybody who officially worked in Belgium has some derived rights (social security, pension funds) pushing them to inform authorities of a new address even if that is not legally required. Moreover, when people leave, their departure does not stay unnoticed very long at the municipality. It is exceptional indeed that people leave their house without others coming in. A new arrival at an address always causes corrections concerning the former inhabitants. If necessary a police patrol is send to the address in order to take notice of the departure of former residents. Very often utility companies or the taxing authority inform municipal authorities of the problem and a correction is entered in the register.

However, it is theoretically possible that someone leaves the country and remains in the national population register. This can be the case when one member of the household emigrates and the remaining household has no reason or (financial) incentive to declare this departure to the authorities.

The hypothesis has been advanced that mortality rates of minorities may artificially be lowered by age underestimation (Elo & Preston, 1994). In the present analysis rates cannot be affected by this mechanism as the population register contains the exact date of birth. Immigrants are required to produce a birth certificate on the occasion of their inscription in the register. In the studied sub-populations the exact date of birth is only missing for a few individuals. In most of those cases at least the month of birth was attested by a local authority. This problem may have some influence in the study of mortality of the oldest migrants, but certainly not in the selected adult population.

The population is organised by nationality of origin in 9 groups and a rest category. Not the actual nationality, but the country of origin is used as much as possible to distinguish the different migrant communities. Nationality, former nationality, place of birth and nationality of the mother were used in order to maximise population groups of Italian, Spanish, Moroccan, Turkish and Black African origin. The population originating from the neighbouring countries (France, Germany and the Netherlands – Luxembourg has been put together with Germany) is included in the analysis as a control group. The population of Belgian origin and a rest group of migrants from all other countries constitute the two remaining groups. Table 1 gives a summary description of the data.

2.2. **Data on cause specific mortality**

In a second stage the database was extended to cause-specific mortality by individual linkage with death certificates. Cause specific mortality is an important clue to explain the diversity in health outcomes. Traditional analyses of cause specific mortality among migrants were based on death certificates, giving the numerators, and another source (census, register) giving the midyear population as the denominator. Apart from the classical numerator- denominator problem, there always existed uncertainty about both sources covering the same populations given the importance of immigration and emigration in migrant communities.

To avoid this source of incertitude, death certificates of 1991-1995 were linked to the population register. The linkage was based on anonymous data using a large set of variables to match both data sources on the individual level. For more than 85% of death certificates it was possible to find a unique match with the death registration in the population register. For the remaining 15% a probabilistic linkage was performed trough an algorithm using date of birth and death, sex and commune of residence. For more than 98% of people registered at census time and dying during the follow-up period a match was established. For less than 2% no match could be found, sometimes due to minor errors in the death certificates[2].
However, the most important reason for non-matching is that a number of death certificates are simply missing. When the place of death is outside Belgium, no Belgian death certificate is made up and subsequently the register of death certificates bears no trace of this death. The population register however, has been notified by the family or by an administration that the person passed away. Of 102.489 deaths in the National Population Register for the year 1992 it was possible to link 100.697 records with death certificates. For 1.792 persons no match was found. Immigrants have a significantly higher probability to decease being abroad than Belgian nationals. Generally, migrants reside more often and for longer periods of time abroad for holidays or family visits. Therefore, using only the death certificates introduces the risks of underestimating the mortality of migrant sub-populations. This error can now be avoided. The National Population Register informs us about the exact date of death, only the information on the cause of death is lacking.

We can conclude that the population register is fairly accurate in registering death, but also that non establishment of death certificates for death occurring outside Belgium causes a large proportion of unknown causes of death, especially for some migrant communities.

The certificates of death in the period under study used the 9th International Classification of Diseases. Our classification of causes of death is based on the underlying cause of death concept as defined by the WHO. It represents the cause of death considered the most relevant, as reported on the death certificate. As our analysis is limited to the 25-54 age group, we assume the information on causes of death to be relatively accurate, even for the migrant population.
The aggregation used follows the general lines of the classification adopted by the 9th ICD. Major single causes of death such as suicide, diabetes mellitus or breast cancer are taken separately. The other causes are regrouped according to the chapters or subchapters used by the ICD 9. One major exception are alcohol related diseases. All deaths caused by alcohol abuse, be it chronic or acute, were put together independently from the chapters of ICD 9.
The aim was to regroup all causes of death in groups that are large enough, have a similar aetiology and do not exceed an acceptable level of uncertainty in terms of diagnosis or classification.

[2] Linkage of records with errors was only accepted if the probability of a correct match substantially surpassed the probability of an incorrect match. (Probability tests were performed by comparing the results of internal linkage. Internal linkage is a method to calculate the probability to find identical records within the databank when some pieces of information are dropped.)

2.3. Methods

We started by looking at age-standardised total and cause specific mortality rates by sex and sub-population. We applied the direct standardisation method by one-year age groups, using the population of Belgian origin as standard.
The Comparative mortality rate (or standardised death rate) is computed by applying the age distribution P_x of the population of Belgian origin as weighting factor to the age-specific mortality rates m_x of sub-population s for cause specific mortality c.

$$CMR_{c,s} = \sum m_{x,c,s} * P_x / \sum P_x$$

Evidently, the sum of all standardised cause specific rates equals the total standardised age-specific mortality.

To estimate the impact of socio-economic status we used a Cox regression analysis. Compared to standardised mortality rates, Cox has the advantage of taking directly into consideration the specific age structure of each sub-population. Cox regression can be considered as a shortcut for traditional life table analysis. The Cox model estimates a non-parametric baseline hazard of failure on point in time (t), conditional on survivorship up to point in time (t-1). The register records all deaths and emigrations, thus enabling an exact definition of exposure time, to death or to censuring, either because the person left the country, or because they were still alive at the final date of follow-up. The duration was expressed in days. For each covariate, the model estimates the multiplicative effect on the hazard of a unit increase in the covariate. For categorical covariates a contrast value was defined, the result indicating the proportional effect of each variable on the baseline hazard compared to the contrast value.
If h(t) is the hazard at time (t), then the model for the hazard can be represented as: $h_i(t) = h_0(t) * \exp(B_1x_1 + B_2x_2 + \ldots B_nx_n)$.
The dependent variable is the risk of mortality before the end of the observation period. In the basic model independent variables include the different sub-populations and age by one year period. Age is introduced as a continuous covariate, as total mortality progresses proportionally with age in this age group. The Cox regression is applied separately by gender. In subsequent models educational level and housing are introduced as controlling factors.
The reference category in educational level consists of the highest level of education (tertiary education) having the lowest level of mortality, so that other educational levels show relative risks compared to the baseline of Belgian men aged 25 with the highest educational level.
Housing is a composite variable obtained by the combination of ownership with comfort. Analysis of Belgian population census data demonstrates that the housing variable is a good proxy for income and wealth. Here again, the group with lowest mortality, house owners living in a house with high comfort are chosen as reference category.

The study of cause specific mortality by sub-populations is useful to identify factors that make some populations healthier than others. With Cox regression we can

estimate the significance of differences in specific causes of mortality and position each of the different nationalities relative to the Belgian reference population for a specific mortality cause.
The dependent variable is defined as a dichotomous outcome: each cause of death separately against all other causes of death, surviving or emigrating
As we want to focus on the factors that make some populations healthier than others, the importance and the role of specific causes of mortality in the resulting general mortality must be estimated.
Therefore we compare mortality patterns of migrant communities to the native Belgian population using a simple decomposition technique based on the table of directly standardised cause specific mortality for each nationality.
The method estimates the contribution of each cause of death to the difference in total mortality between each sub-population and the population of Belgian origin. This gives an idea of the contribution of specific causes of death in the resulting lower total mortality rate. The results do not permit a comparison between nationalities, because similar magnitudes of contribution can hide enormous differences in absolute mortality figures. But the graphical representation creates footprints that allow a first easy reading of the contribution of different causes of mortality in the total outcome. Proportionate contributions of causes of death sum to one

The question of unidentified causes of death presented a specific problem. To cope with this problem, we redistributed the unlinked causes over all other causes of death on a proportional basis. Although a very rough method it permits diminishing the underestimation of specific causes. As we can assume that people who are seriously ill are less inclined to travel, there is probably a slight overestimation for deaths by chronic diseases (cancers, chronic obstructive pulmonary disease) and a possible underestimation of causes of sudden death such as traffic accidents and ischaemic heart diseases. But lacking other information, proportional redistribution seems most acceptable.

3. Unravelling bias and selection hypotheses.

In preparing the data for analysis of cause specific mortality, attention was paid to the existing hypotheses of bias and selection.

The **salmon bias hypothesis** has in fact two possible ways to operate (or is introduced in two different ways into the literature):
1. The first argumentation states that people on the verge of dying (as the returning salmon) are going back to their country of origin. The proposition is that even if their emigration is registered, mortality figures are seriously biased because by quitting the country just before dying the numerator is artificially low.
2. The second elaboration of the salmon bias hypothesis argues that people leave the country without being registered as emigrants. This affects both numerator and denominator. As they are still supposed to be in the country, they contribute to the population at risk. But their death outside the country is never registered and they become statistically immortal.
With a small population at risk, a few cases can be very disturbing especially when measuring mortality at old ages.

Several arguments have been advanced in the literature stating that the salmon bias hypothesis can be refuted based on logic reasoning. Why should people who are seriously ill return in their home country where health care is less developed than in the migration country? Why should they leave their family when dying? The entire logic of pension funds and health infrastructure does not support this hypothesis; neither does the fact that family ties and children withhold them in their new country. Older emigrants, once retired and no longer bound by work and small children, often stay for longer periods in their country of origin. But this hardly applies to the selected age group.

Supposing all emigration is registered, one can also calculate hypothetical mortality rate emigrants would need to have if a salmon bias is at work. Applying mortality rates of the Belgian population to the migrant group gives the theoretical number of deaths that would be observed if mortality of the migrant group would equal mortality of the Belgian population. Subtracting the number of observed deaths estimates the difference that has to be generated by emigrants of this sub-population.

Table 4 shows that mortality rates among this population would need to be extremely high to compensate their low mortality in Belgium. We can conclude that based on official registered emigration the salmon bias hypothesis can be dismissed for the adult population.
One might then argue that even with mortality rates a tenfold the normal rate, absolute numbers are still small and can easily be ignored in the country of origin. On the other hand, as many Moroccan and Turkish migrants originate from the same cities or villages, this level of mortality would surely have been remarked.

The second working hypothesis of the salmon bias effect is based on unnoticed emigration. In a system of a computerised and centralised population register, this is most probable to occur when one of several members of a household leaves the country, while others are staying. (Adolescents leaving the parental home, older persons leaving their children,...). This, however, seems most unlikely for the adult population in working age. We can simulate the unobserved number of people that would have to leave the country to influence mortality figures as to obtain the same mortality rate as the Belgian population. The calculation is simplified by applying standardised mortality rates and a theoretical maximum exposure time of 58 months to obtain the unobserved deaths.

N population at risk = N deaths * 100.000 / CMR * Maximum Exposure time

This rough calculation suffices to demonstrate the huge number of unnoticed return migration necessary for some nationalities to explain low mortality as a result of “statistical immortality” (Table 5).

There is yet another approach possible for this problem of estimating the importance of unregistered death of people who were in the census (and ipso facto in the population register). As mentioned earlier, unregistered death occurs when people die outside of the country. In the case of Belgian nationals, the diplomatic representation will be informed and a time lag in the registration is the only problem that can occur. (Although the registration enters the correct date of decease, some information can be missing at the time of analysis).
The situation is different for the death of a person without Belgian nationality. In absence of work and without an incentive for relatives to declare the death outside Belgium, some cases can stay unnoticed. To estimate the importance of the problem a distinction was made within each group between those who acquired the Belgian nationality and the others. Survivorship analysis using Cox regression only revealed a potential problem for the Turkish population. The relative risk of dying was found to be significantly higher for those who acquired the Belgian nationality indicating that mortality among the others may be underestimated.

Considering we merely tried to equal the mortality rate of the Belgian population, while most migrant populations have a marked socio-economic disadvantage, we can conclude that the salmon bias hypothesis cannot explain the “migrant paradox”, at least not in the Belgian case.

The data at hand are less helpful to evaluate the selection hypothesis. The “healthy migrant” hypothesis explains lower mortality of adult migrants compared to the host population by a selection process in the population of origin. It is quite obvious that general health among migrants measured shortly after migration is probably better than the health of the population they originate from. However, the effect of health selection can only influence mortality in the period immediately after migration or lower the incidence in the migrant population for some specific chronic health problems such as mental illness. It is difficult to imagine the influence of a selection process in the country of origin that would be responsible for lower cancer mortality several years later. Specific mortality patterns can thus be useful to estimate the possible influence of selection processes.

4. Results

Table 7 gives a general overview of the different causes of death and the comparative mortality rates for all nationality groups. Table 8 presents the comparative mortality figure of specific mortality causes for the different migrant groups. The comparative mortality figure gives the ratio of the age-adjusted cause specific death rate for a sub-population to the mortality rate of the Belgian population. A comparative mortality figure of less than one indicate that the sub-population has a lower mortality rate for this cause than the Belgian population.

Table 9 presents the result of a Cox regression analysing differences in total mortality and represents the exponential coefficients Exp(B). This coefficient indicates the relative risk of each sub-population expressed relative to the baseline hazard of Belgians. All male populations have a lower relative risk than the Belgians, except the French. Germans and Africans do not differ significantly from the Belgians. The relative risk of Moroccan male population is lowest with an exp(B)= 0,65.
Among women, the relative risk of Africans is significantly higher than for Belgians, whereas German and French do not differ significantly. Dutch women have the lowest relative risk. After control for education, the relative risk of several migrant populations is even lower, especially for the Moroccan and Turkish community. This shows that these groups have a lower mortality than could be expected on the basis of their educational level. Control for the housing variable is operating in the same direction, meaning that most migrants have a better mortality profile than could be expected from their socio-economic status. The reduction of the relative risk for French men and African women shows that their socio-economic status is partially responsible for the high mortality compared to Belgians.

Obviously, important causes of death are the prime suspects to explain important differences in total mortality between population groups.

In absolute terms ischaemic heart disease is the single main cause of medical death for both sexes taken together, followed by lung cancer. However, in these age categories, external causes of death take a heavy toll too, suicide being the most important, responsible for one tenth of all deaths.
Looking at both sexes separately, the image is very different for men and women. Apart from the fact that male mortality is about twice as high as female mortality, we also have a different proportional distribution of cause specific mortality. Suicide, ischaemic heart disease and lung cancer are the three main causes of death among men, all about in the same order of importance. Among women in this age group, breast cancer is the dominant cause of death, followed by suicide.

Table 10 shows the result of Cox regression for the main causes of death: suicide, lung and breast cancer and ischaemic heart disease. Age has been entered as a categorical variable because of the non-linear relationship between age and mortality for some specific causes of death. Taking into account possible artificial differences caused by diagnostic problems, we also grouped all heart diseases, except cerebrovascular diseases and “other diseases of the circulatory system”. Because of their particular position in the cause specific differences in migrant mortality, we also added infectious and parasitic diseases, alcohol-related mortality and cancers of the digestive system.

Turkish and Moroccan men have more favourable relative risks for virtually all causes. The exception (although not significant at the 95% C.I.) is mortality of infectious and parasitic diseases and traffic accidents among Turkish men. For most causes the lower relative risk is significant, except for lung cancer and ischaemic heart disease among Turkish men. Taking all heart diseases together, the main results stay identical, although relative positions of Moroccan and Turkish men become more comparable. The relative risk of Italian men also becomes significantly lower than that of Belgian men.

The clearest contrast is observed for suicide and alcohol in the Islamic migrants and the Italian community. Lung cancer is also low for Moroccans, as is cancer of the breast for Moroccan, Turkish, Italian and Dutch women. Cancer of the digestive system shows a slightly different pattern. It is one of the few lower relative risks for African men.

Introducing socio-economic status (not presented) does not change much at this general pattern, except for reducing the relative risks of migrant population, as could be expected from earlier results in total mortality. Suicide is an exception; after control for education there was an increased risk for French and Dutch women.

Figure 1 reports results of a decomposition of the contribution of specific causes of death for the lower total mortality for some selected nationalities. Groups are analysed against the background of the Belgian population and cannot really be compared. The chart shows contributions of specific causes to the generally better outcome. On the right hand side one can find the causes that contribute to lower mortality. Causes with a relatively higher mortality are pointing to the right as they have a negative influence on the general outcome. For African women, with a less favourable mortality risk than the Belgian women, the graph shows the contribution of specific causes in the higher mortality rate.

5. Discussion

1. The patterns in figure 1 can be considered footprints of cause specific mortality operating differently by nationality. Cause specific patterns give a consistent image of the origin of the differences in total mortality rate. In general, migrant communities, given their overall lower mortality rate, can be expected to have a lower relative risk for most causes. However, one should be aware of a possible underestimation of total mortality in too one-sided graphs (Moroccan men, Italian men and women).
It is however possible to discern specific causes contributing most to the low total mortality rate. Lower rates for specific diseases are indeed not proportionally distributed and just a few sets of causes are responsible for the bulk of the difference.

Suicide appears to be the first explaining factor for the lower mortality among Moroccan, Turkish and Italian men. This demonstrates the importance of the cultural or religious factor, suicide being a strong taboo in Islamic countries. Southern European countries are also known to have very low suicide figures.

Religion also plays a role in a series of other causes. Health behaviour appears to be of tremendous importance in contemporary mortality of adults. The interdiction of alcohol consumption in Islam results in extremely low figures of alcohol related mortality among Moroccan and Turkish men.
In the epidemiological literature, moderate consumption of alcohol is stated to have some positive effects, but abuse of alcohol results in high alcohol related mortality figures (France). Abuse of alcohol can also have a negative indirect effect on other causes of mortality. A strong relationship has been demonstrated with suicide, traffic accidents, liver and gall bladder diseases and cancers of the oesophagus. Thus probably there is also an indirect positive effect in the Islamic communities on all these causes of death.

As Islamic faith does not prohibit use of tobacco, no protective role regarding this aspect of health behaviour is observed. Moroccan adult men are known to be moderate smokers and consequently have significantly lower lung cancer rates. The cultural attitude towards smoking for women still results in extremely low lung cancer deaths in the Turkish and Moroccan communities. It is plausible that smoking behaviour is also partially responsible for the low ischaemic heart mortality among Moroccan men. Lung cancer mortality among Turkish men is among the highest, on the same level as Belgian and French men.

Concerning female mortality, lower incidence of breast cancer among Turkish and Moroccan women is an important factor in general lower mortality. This finding fits in with the theory of early childbearing as a main reductive factor.

Infectious and parasitic diseases constitute the most notable exception with higher mortality for almost al migrant groups. But this cause of mortality is relatively unimportant in absolute numbers and does not much influence the total mortality level. The extremely high relative risks for the African community, both among men and women, also reflects the influence of HIV among this migration group in the early nineties.

2. The cause specific decomposition mainly explains the relative importance of specific causes and factors for the low (or the high) mortality rates of sub-populations compared to the host population. In this way it also acts as a mirror for the host population.
The fact that most migrant communities (except the French and the African women) do have a lower total mortality is indicative for the potential improvement in public health that can still be attained in a rich and highly developed society as Belgium. Comparing Belgian health expectancy figures to other countries also shows that there is still a margin for improvement. However, the advantage of the present research is that we can exactly pinpoint major causes where progress can be made. One of the most evident observations is the dominant role of man-made causes of death in generating mortality differentials between the Belgian and migrant male population. For adult Belgian men, alcohol abuse, tobacco consumption, traffic accidents and suicide are the main causes of death. And 3 out of these 4 contribute immensely to the migrant mortality advantage. For traffic accidents, the advantage is less clear cut, with Turkish men even having higher mortality rates.

3. The decomposition is interesting to analyse sub-population differences, but the standardised mortality rate is the best measure to make a global comparison over the entire spectrum of nationalities. In that respect, it is important to underline how strongly cause specific mortality can differ between populations. When we add gender differences into the picture it is even clearer that many deaths in this age group are with good reason classified as "preventable mortality", lending more support to the thesis that differences in total mortality are not an artefact.
In a certain way it also gives some credit to the assumption that the gender gap in life expectancy is for an important part due to "preventable mortality" caused by unhealthy behaviour and working conditions among men. In recent years there was a continuous improvement in life expectancy, much related to better health behaviour. Between 1954 and 1994 there was a fourfold increase in lung cancer mortality among men in Belgium. The diminishing proportion of cigarette smokers among men is now finally inverting this trend, improving life expectancy and contributing to a reduction in the life expectancy gap between men and women. However, the differences in standardised lung cancer mortality between Moroccan women and Belgian women show how much more improvement is possible. The highest female lung cancer rate (13 per 100.000 for German women) is still below the lowest rate for men (Moroccan with 18 per 100.000), but the differences inside each gender-group are much more important.
External causes of mortality, and especially suicide, are consistently, and tremendously more important for men than women, over all nationalities. Only the Turkish - and to a lesser extent the Italian - population shows a sex ratio for suicide under two.

4. We have to keep in mind that adult mortality is only one aspect of the global health situation of migrant communities. Looking at the broader picture of total life

expectancy we have a much bleaker image. Perinatal mortality is more than double the Belgian rate among the Turkish and Moroccan population and has been so for many years (Peters & Van der Veen, 1990; Gezondheidsindicatoren, 1996). Mortality among young children has for a long time been reported to be higher in migrant communities in Belgium (Maffenini, 1980).

Especially alarming is the mortality among young Moroccan men, under the age of 25. A similar kind of “anomaly” has been signalled by Hayes-Bautista e.a. (2002) concerning Latino male adolescents. Further analysis is needed to conclude whether this adolescent mortality peak in the Maghreb community announces an important surge in mortality among Moroccan adults.

Finally, all information about morbidity among adult migrant populations reveals a sharp contrast with the more favourable mortality rates. Both health-surveys (1997 and 2001) report subjective health to be worse among the Islamic migrant communities than among the Belgian population. The census of 2001, introducing some new questions about subjective health, gives additional support to these negative findings. Regarding their socio-economic status and compared to the Belgian population, adult migrants of some Mediterranean countries have lower mortality, but do not necessarily have a better health. The Turkish migrant population, with a lower total mortality than the general population, emerges with the most disadvantaged health indicators. Morbidity is more consistent with the lower socio-economic position of the Turkish community. Lower mortality appears to be the result of a more protective diet, less alcohol consumption and very few suicides compared to the native population. The contrast between mortality and morbidity is frequently reported when analysing gender differences, pointing in the same direction: mortality is merely an indicator of the importance of lethal diseases, but not necessarily of general health.

Conclusions

In general, the results are in line with the findings in much of the literature. Bringing all the elements together allows us to draw up a much broader portrait of the immigrant health, where lower mortality does not necessarily imply better health.

Salmon bias cannot explain differential mortality and cause specific mortality patterns. A small effect of statistical immortality is possible and most probable for Turkish women. But the reasons for the paradox appear to be multifactorial and at least a combination of life style, dietary intake variations and the health infrastructure of the host country.

Cause specific mortality patterns are consistent with our knowledge about health behaviour, life style and diet of migrant populations. Lower adult mortality among some migrant communities is related to a small number of specific causes mostly depending on health behaviour. Low suicide prevalence is of major importance for Islamic and Mediterranean populations. This contrast is particularly important given the very high suicide figures in Belgium. Alcohol consumption and smoking behaviour constitutes a second group. Diet could be a third explaining factor.

The relative advantage especially for the Moroccan community risks disappearing in the near future. Young Moroccan men start to develop very high mortality figures. As the protective health behaviour will disappear, these younger generations will receive the full negative impact of a lower socio-economic status.

The results allow for a better orientation of health services to specific sub-populations. The much better outcome for some causes of death among populations with a low socio-economic status shows the potential for improvement of the health status of the general population.

Table 1: Summary of data

subpopulation aged 25-54 (1991)	Number of men	population-years at risk male population	N male deaths	N male emigrants *	Number of women	population-years at risk female population	N female deaths	N female emigrants*
Germany	18499	83561	257	1934	22056	100568	173	2070
Netherlands	14887	69076	148	1035	14790	68799	64	1039
France	36325	165469	728	3212	41301	191843	369	2672
Sub Sahara Africa	25550	114275	275	3080	22028	101934	181	1510
Italy	76647	362913	817	2113	67213	319729	388	1580
Spain	24339	110710	311	2325	24205	110910	175	2063
Turkey	16575	78294	173	585	14621	69672	76	332
Morocco	30463	144149	297	963	24562	117596	145	339
Belgium	1787030	8547490	27892	12339	1749963	8405051	14726	8368
other	66364	288650	680	11056	63141	277171	372	9588

Source: census 1991 linked with mortality and emigration Population Register 1991-1995
* Emigrants = official emigration & administrative removal from the Population Register

Table 8: Comparative Mortality Figure

	men							
	France	Germany	Africa*	Spain	Turkey	Italy	Netherl.	Morocco
infectious and parasitic diseases	2.71	1.16	4.91	1.66	1.28	1.40	2.81	1.42
cancers of the tractus digestivus	1.42	0.82	0.30	0.76	0.70	0.50	0.39	0.50
cancers of trachea, bronchus and lung	1.06	0.62	0.60	0.69	0.94	0.89	0.76	0.54
cancer of breast								
cancers, unspecified and others	1.22	0.90	0.82	0.71	1.02	0.68	0.85	0.96
diabetes mellitus	1.03	0.00	0.00	0.54	0.00	0.88	0.00	0.95
alcohol related mortality	1.52	0.93	1.09	0.47	0.08	0.74	0.14	0.12
mental disorders	0.68	1.02	0.00	0.53	1.43	0.54	0.00	0.00
ischemic heart disease	1.08	1.01	0.67	0.87	0.65	0.96	0.68	0.59
other heart diseases	1.17	0.91	1.96	1.14	0.92	0.63	0.65	1.07
cerebrovascular diseases	0.68	1.32	0.55	1.03	1.05	0.81	0.19	0.71
other circulatory diseases	1.88	0.56	0.68	0.46	1.21	0.61	0.51	0.28
pneumonia/influenza	1.21	2.71	1.84	0.40	0.00	0.55	1.25	0.73
copd	1.74	1.65	0.20	1.27	0.52	0.63	0.19	1.14
liver and gall bladder diseases	1.80	1.63	0.62	0.32	0.27	0.64	0.52	0.31
symptoms and ill-defined conditions	1.81	1.29	1.11	1.13	0.37	0.95	0.27	0.94
other diseases	0.89	1.40	1.25	0.87	0.88	0.75	1.36	0.58
traffic accidents	1.19	0.87	0.98	0.91	1.30	0.75	0.68	0.60
accidental falls	1.28	0.47	0.12	0.38	1.03	0.99	0.85	0.46
other accidents	1.56	1.17	0.83	0.78	0.88	0.76	1.54	0.51
suicide	1.45	0.97	1.06	0.90	0.28	0.41	0.67	0.34
injuries	1.45	1.29	1.04	0.93	0.92	1.19	0.47	1.59
other external causes	2.14	0.62	1.12	0.71	2.45	1.21	0.82	0.99
total mortality	1.31	0.97	0.92	0.82	0.79	0.74	0.71	0.65

	women							
	France	Germany	Africa*	Spain	Turkey	Italy	Netherl.	Morocco
infectious and parasitic diseases	0.21	2.55	17.21	1.16	0.00	0.83	0.67	0.43
cancers of the tractus digestivus	0.62	0.61	1.51	0.96	1.21	0.89	0.97	1.65
cancers of trachea, bronchus and lung	1.07	1.63	1.21	1.26	0.87	0.74	0.69	0.00
cancer of breast	0.97	0.52	0.70	0.81	0.10	0.74	0.58	0.63
cancers, unspecified and others	0.88	0.93	1.31	0.92	0.95	0.73	0.72	1.13
diabetes mellitus	1.61	1.62	6.46	0.54	1.75	0.27	2.34	3.34
alcohol related mortality	2.77	1.16	0.20	0.58	0.00	0.37	0.67	0.41
mental disorders	1.14	1.60	0.00	0.00	0.00	0.00	0.00	2.72
ischemic heart disease	0.80	1.48	0.32	0.84	1.41	0.99	0.22	0.88
other heart diseases	1.15	1.55	0.70	1.37	0.87	0.60	0.49	1.08
cerebrovascular diseases	1.01	0.19	1.85	0.20	1.23	1.17	0.59	0.94
other circulatory diseases	1.47	0.58	0.53	0.00	2.66	0.40	0.49	0.26
pneumonia/influenza	0.40	0.92	0.00	1.24	2.06	0.81	0.00	0.00
copd	0.93	1.05	1.47	1.39	3.42	1.07	0.00	0.73
liver and gall bladder diseases	1.92	0.52	0.50	0.49	0.00	0.73	0.58	0.32
symptoms and ill-defined conditions	0.94	2.41	2.57	0.53	0.65	0.65	0.36	2.05
other diseases	0.77	0.54	2.31	0.89	0.88	0.75	0.66	0.75
traffic accidents	1.06	0.72	0.85	0.47	0.70	0.86	0.17	1.18
accidental falls	2.24	0.76	0.94	0.45	0.00	0.00	1.12	0.67
other accidents	0.87	1.08	0.97	0.68	0.00	0.14	1.36	0.75
suicide	1.01	1.14	0.90	0.87	0.59	0.64	0.34	0.13
injuries	1.28	1.85	1.59	1.58	0.00	1.14	0.00	0.00
other external causes	2.10	1.58	1.15	0.87	3.23	0.92	0.57	2.59
total mortality	1.05	0.96	1.38	0.83	0.83	0.74	0.58	0.87

* sub Sahara Africa

Comparative Mortality Figure: ratio of age-adjusted death rate for a migrant population to the Belgian population death rate

Table 7: Comparative Mortality rates for women

causes ICD 9	**Belgian**	**Germany**	**Netherl.**	**France**	**Africa***	**Spain**	**Italy**	**Turkey**	**Morocco**	**other**
infectious and parasitic diseases	2.29	5.85	1.53	0.48	39.44	2.65	1.89	0.00	0.99	3.53
cancers of the tractus digestivus	9.57	5.79	9.26	5.92	14.41	9.22	8.51	11.60	15.80	8.93
cancers of trachea, bronchus and lung	8.11	13.25	5.61	8.66	9.80	10.20	5.99	7.03	0.00	8.81
cancer of breast	29.14	15.02	16.82	28.22	20.51	23.49	21.47	2.80	18.28	20.60
cancers, unspecified and others	34.37	31.86	24.76	30.14	44.88	31.66	24.99	32.72	39.00	25.81
diabetes mellitus	1.34	2.16	3.12	2.15	8.63	0.73	0.36	2.34	4.46	1.33
alcohol related mortality	6.03	7.00	4.05	16.73	1.19	3.50	2.26	0.00	2.45	1.24
mental disorders	0.90	1.44	0.00	1.03	0.00	0.00	0.00	0.00	2.46	0.72
ischemic heart disease	7.61	11.27	1.71	6.12	2.47	6.40	7.54	10.73	6.66	5.38
other heart diseases	6.12	9.49	3.02	7.05	4.27	8.37	3.65	5.30	6.63	4.27
cerebrovascular diseases	7.74	1.47	4.53	7.79	14.29	1.53	9.07	9.49	7.24	7.01
other circulatory diseases	3.47	2.01	1.71	5.12	1.84	0.00	1.40	9.25	0.91	1.58
pneumonia/influenza	1.21	1.11	0.00	0.48	0.00	1.49	0.97	2.48	0.00	1.28
copd	3.31	3.46	0.00	3.09	4.88	4.61	3.56	11.32	2.41	3.47
liver and gall bladder diseases	3.87	2.02	2.23	7.42	1.91	1.90	2.81	0.00	1.25	3.04
symptoms and ill-defined conditions	5.13	12.35	1.82	4.81	13.18	2.74	3.34	3.32	10.54	6.22
other diseases	10.85	5.87	7.17	8.38	25.12	9.63	8.12	9.59	8.11	9.81
traffic accidents	7.60	5.46	1.30	8.06	6.46	3.59	6.53	5.30	8.96	5.31
accidental falls	1.48	1.11	1.65	3.31	1.38	0.67	0.00	0.00	0.98	1.12
other accidents	2.43	2.63	3.31	2.11	2.35	1.66	0.34	0.00	1.82	3.02
suicide	14.14	16.11	4.77	14.26	12.71	12.35	8.98	8.28	1.90	12.44
injuries	1.82	3.36	0.00	2.33	2.89	2.88	2.07	0.00	0.00	4.35
other external causes	3.21	5.07	1.83	6.74	3.69	2.78	2.94	10.36	8.31	3.44
cause unknown	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
total mortality	171.74	165.18	100.22	180.41	236.32	142.05	126.78	141.91	149.14	142.71

women aged 25-54 census 1991 - mortality in follow-up period 1991-1995
Direct standarization applying age specific and cause specific mortality of the subpopulation on Belgian standard population
after proportional redistribution of missing death certificates over all causes of death
* sub Sahara Africa

Table 6: Comparative Mortality rates for men

causes ICD 9	Belgian	Germany	Netherl.	France	Africa*	Spain	Italy	Turkey	Morocco	other
infectious and parasitic diseases	6.42	7.45	18.03	17.37	31.49	18.03	8.98	8.23	9.08	16.20
cancers of the tractus digestivus	24.72	20.20	9.68	35.20	7.44	9.68	12.36	17.24	12.41	8.19
cancers of trachea, bronchus and lung	34.85	21.57	26.38	36.81	20.74	26.38	31.05	32.78	18.83	18.01
cancers, unspecified and others	40.19	36.10	34.12	49.10	33.01	34.12	27.36	40.95	38.43	32.34
diabetes mellitus	3.40	0.00	0.00	3.50	0.00	0.00	3.00	0.00	3.25	3.56
alcohol related mortality	14.07	13.08	1.94	21.34	15.36	1.94	10.36	1.16	1.68	12.50
mental disorders	1.55	1.58	0.00	1.06	0.00	0.00	0.83	2.22	0.00	3.81
ischemic heart disease	36.33	36.66	24.61	39.19	24.24	24.61	34.93	23.55	21.44	25.71
other heart diseases	15.91	14.54	10.40	18.68	31.19	10.40	10.09	14.61	16.95	11.42
cerebrovascular diseases	9.80	12.89	1.88	6.62	5.35	1.88	7.90	10.26	7.00	9.23
other circulatory diseases	5.74	3.21	2.92	10.78	3.89	2.92	3.53	6.95	1.63	2.34
pneumonia/influenza	2.35	6.38	2.95	2.84	4.33	2.95	1.29	0.00	1.73	1.60
copd	6.31	10.40	1.21	10.96	1.25	1.21	3.99	3.31	7.18	3.55
liver and gall bladder diseases	8.01	13.04	4.20	14.39	4.99	4.20	5.09	2.14	2.51	4.88
symptoms and ill-defined conditions	11.29	14.59	3.09	20.44	12.51	3.09	10.77	4.12	10.57	8.52
other diseases	16.25	22.68	22.08	14.49	20.32	22.08	12.14	14.26	9.45	10.83
traffic accidents	26.41	22.99	18.08	31.44	25.80	18.08	19.91	34.32	15.74	17.89
accidental falls	4.91	2.30	4.19	6.30	0.57	4.19	4.85	5.04	2.26	5.21
other accidents	7.58	8.89	11.71	11.85	6.30	11.71	5.78	6.65	3.90	4.29
suicide	38.23	36.92	25.57	55.43	40.40	25.57	15.48	10.77	13.02	23.95
injuries	4.02	5.18	1.88	5.82	4.20	1.88	4.78	3.71	6.39	7.87
other external causes	5.61	3.50	4.58	11.99	6.29	4.58	6.76	13.76	5.56	12.02
total mortality	323.95	314.15	229.49	425.60	299.64	229.49	241.24	256.03	209.00	243.94

men aged 25-54 census 1991 - mortality in follow-up period 1991-1995
Direct standarization applying age specific and cause specific mortality of the subpopulation on Belgian standard population
after proportional redistribution of missing death certificates over all causes of death
* sub Sahara Africa

Table 4: Calculation of required mortality rate in return migration to equal Belgian mortality rate

Men 25-54 (census 1991 - mortality 91-95)

				N deaths				
subgroup	N	TMR 25-54	CMR	Expected*	Observed**	Difference	N emigrants***	Mortality rate****
Sub Sahara Africa	25550	241	300	279	275	4	3080	28
Germany	18499	308	314	263	257	6	1934	65
Netherlands	14887	214	229	207	148	59	1035	1186
France	36325	440	426	558	728	-170	3212	-1096
Spain	24339	281	266	377	311	66	2325	584
Italy	75830	225	241	1112	817	295	2113	2891
Turkey	16402	221	256	214	173	41	585	1462
Morocco	30166	206	209	450	297	153	963	3285

* The total mortality rate for the 25-54 subpopulation when Belgian age specific mortality is applied to the subpopulation

** The total absolute number of deaths of the subpopulation

*** Sum of all return migration, official and unofficial ("administrative removed" from the population register)

**** Theoretical mortality rate of return migrants to counterbalance the migrant mortality advantage

Table 5: Calculation of required return migration to equal Belgian mortality rate

Men 25-54 (census 1991 - mortality 91-95)

				N deaths						**
	N	TMR 25-54	CMR	Expected	Observed	Difference	N emigrants	N deaths *	Difference	surplus migration
Sub Sahara Africa	25550	360	300	279	275	4	3080	45	-	-
Germany	18499	308	314	263	257	6	1934	29	-	-
Netherlands	14887	214	229	207	148	59	1035	11	48	4313
France	36325	440	426	558	728	-170	3212	66	-	-
Spain	24339	281	266	377	311	66	2325	30	36	2783
Italy	75830	225	241	1112	817	295	2113	25	271	23211
Turkey	16402	221	256	214	173	41	585	7	34	2757
Morocco	30166	206	209	450	297	153	963	10	143	14174

* potential N of deaths among return migration applying standardised rates

** N of additional unofficial return migration required to counterbalance mortality advantage

Table 3: N of causes of death without link to mortality certificates

	men			women		
sub-group	*N*	*total mortality*	*%*	*N*	*total mortality*	*%*
other	56	680	8.24	28	372	7.53
neighbours	98	1296	7.56	48	717	6.69
sub Sahara Africa	19	275	6.91	10	181	5.52
Spain	12	148	8.11	4	64	6.25
Italy	42	817	5.14	17	388	4.38
Turkey	30	173	17.34	18	76	23.68
Morocco	71	297	23.91	44	145	30.34
Belgium	795	27892	2.85	274	14726	1.86

Table 2: causes of mortality, grouping by ICD-9 coding				
		N deaths 1/3/1991 - 31/12/1995		
cause of death	*ICD-9 codes*	*men*	*women*	*total*
infectious and parasitic diseases	001-139	714	257	971
cancers of the tractus digestivus	140-151, 153-154	2260	915	3175
cancers of trachea, bronchus and lung	162, 163, 165	3241	778	4019
cancer of breast	174, 175	13	2709	2722
other cancers	restgroup 140-239	3768	3245	7013
diabetes mellitus	250	314	134	448
alcohol related mortality	291, 303, 425.5, 571.1, 571.3, 577.0, 577.1, E860	1308	562	1870
mental disorders	rest 290-319	148	82	230
ischemic heart disease	410-414	3408	725	4133
other heart diseases	416, 420-429	1499	584	2083
cerebrovascular diseases	430-438	920	733	1653
other circulatory diseases	restgroup 390-459	531	320	851
pneumonia/influenza	480-487	221	112	333
copd	490-494, 496	597	319	916
liver and gall bladder diseases	570-577	746	363	1109
symptoms and ill-defined conditions	780-799	1086	496	1582
other diseases	restgroup 001-799	1525	1020	2545
traffic accidents	E800-E848, E929.0, E929.1	2482	701	3183
accidental falls	E880-E888	463	140	603
other accidents	E890-E929	711	226	937
suicide	E950-959	3521	1308	4829
injuries	E980-E989	404	180	584
other external causes	restgroup E800-E999	575	317	892
unlinked with death certificate		1123	443	1566
Total mortality		31578	16669	48247
Population aged 25-54 (1/3/1991)		2096679	2043880	4140559

Source: census 1991, Population Register and death certificates 1991-1995

Table 9: Hazard ratio of mortality for population aged 25-54

by national group	**adjusted for**	**age**	**education**	**housing**	**education & housing**	
men	**N**	**Exp(B)**	**Exp(B)**	**Exp(B)**	**Exp(B)**	**CI 95%**
sub Sahara Africa	25550	0.98	1.06	**0.88**	0.93	(0,84 1,04)
Germany	18499	0.99	0.98	0.91	0.92	(0,82 1,02)
Netherlands	14887	**0.72**	**0.61**	**0.58**	**0.54**	(0,46 0,62)
France	36325	**1.29**	**1.19**	**1.09**	**1.06**	(1,00 1,14)
Italy	76647	**0.75**	**0.66**	**0.71**	**0.67**	(0,63 0,71)
Spain	24339	**0.82**	**0.83**	**0.81**	**0.82**	(0,74 0,90)
Turkey	16575	**0.80**	**0.64**	**0.59**	**0.54**	(0,47 0,62)
Morocco	30463	**0.65**	**0.52**	**0.45**	**0.42**	(0,38 0,46)
women	**N**	**Exp(B)**	**Exp(B)**	**Exp(B)**	**Exp(B)**	**CI 95%**
sub Sahara Africa	22028	**1.41**	**1.49**	**1.33**	**1.38**	(1,21 1,57)
Germany	22056	0.96	0.94	0.89	0.89	(0,78 1,01)
Netherlands	14790	**0.56**	**0.50**	**0.46**	**0.44**	(0,35 0,55)
France	41301	1.05	1.01	0.93	0.91	(0,83 0,99)
Italy	67213	**0.75**	**0.69**	**0.72**	**0.68**	(0,63 0,75)
Spain	24205	0.89	**0.87**	**0.87**	0.86	(0,75 0,98)
Turkey	14621	**0.76**	**0.64**	**0.59**	**0.54**	(0,44 0,67)
Morocco	24562	**0.84**	**0.70**	**0.64**	**0.58**	(0,50 0,67)

Independent Cox regression for males and females
Belgian reference group = 1.00
(bold $p < 0.05$)

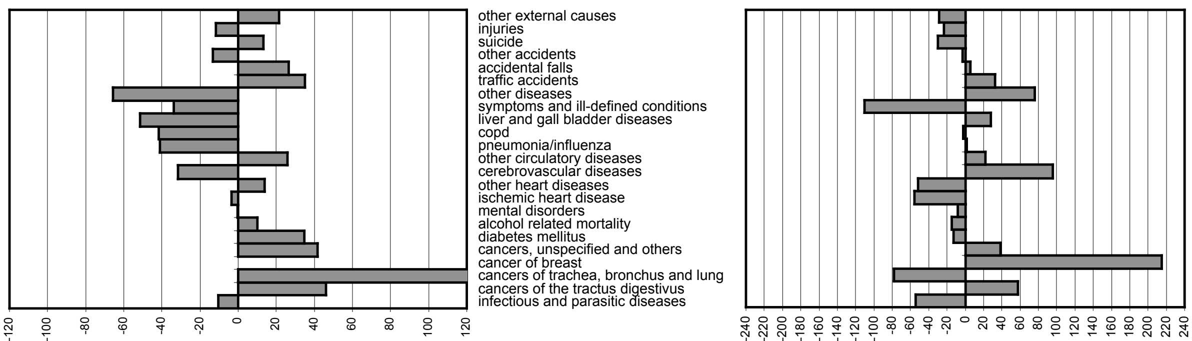
Table 10: Relative Risk and 95% Confidence Intervals for cause specific mortality, by sex, in sub-populations								
	men		women		men		women	
	Ischaemic heart disease				**heart disease (incl. ischeamic)**			
	N=3408		N=725		N=4907		N=1309	
other	0.69	(0.54 - 0.88)	0.64	(0.36 - 1.14)	0.68	(0.56 - 0.84)	0.65	(0.42 - 0.99)
sub Sahara Africa	0.68	(0.42 - 1.10)	0.66	(0.21 - 2.04)	0.91	(0.64 - 1.28)	0.69	(0.31 - 1.54)
Germany*	0.89	(0.60 - 1.33)	1.51	(0.85 - 2.67)	0.89	(0.64 - 1.24)	1.47	(0.96 - 2.27)
Netherlands	0.60	(0.35 - 1.04)	0.21	(0.03 - 1.48)	0.64	(0.41 - 1.00)	0.34	(0.11 - 1.07)
France	1.02	(0.79 - 1.31)	0.78	(0.44 - 1.38)	1.05	(0.85 - 1.29)	0.94	(0.64 - 1.39)
Italy	0.91	(0.75 - 1.11)	0.97	(0.64 - 1.49)	0.82	(0.69 - 0.97)	0.81	(0.57 - 1.14)
Spain	0.81	(0.58 - 1.14)	0.86	(0.43 - 1.73)	0.90	(0.69 - 1.18)	1.08	(0.68 - 1.73)
Turkey	0.62	(0.36 - 1.07)	1.07	(0.40 - 2.85)	0.62	(0.40 - 0.98)	0.86	(0.39 - 1.93)
Morocco	0.46	(0.30 - 0.70)	0.62	(0.23 - 1.65)	0.55	(0.40 - 0.76)	0.75	(0.39 - 1.44)
	lungcancer				**cancers tractus digistivus**			
	N=3241		N=778		N=2260		N=915	
other	0.50	(0.37 - 0.67)	1.01	(0.65 - 1.58)	0.31	(0.20 - 0.48)	0.88	(0.57 - 1.36)
sub Sahara Africa	0.59	(0.34 - 1.05)	1.01	(0.42 - 2.43)	0.37	(0.17 - 0.83)	1.17	(0.55 - 2.46)
Germany*	0.70	(0.44 - 1.11)	1.43	(0.81 - 2.53)	0.83	(0.51 - 1.36)	0.61	(0.27 - 1.36)
Netherlands	0.76	(0.46 - 1.23)	0.58	(0.19 - 1.81)	0.41	(0.19 - 0.92)	1.00	(0.45 - 2.24)
France	1.07	(0.83 - 1.38)	1.05	(0.65 - 1.69)	1.35	(1.04 - 1.76)	0.56	(0.31 - 1.02)
Italy	0.87	(0.71 - 1.07)	0.71	(0.44 - 1.14)	0.48	(0.35 - 0.66)	0.88	(0.59 - 1.31)
Spain	0.65	(0.44 - 0.95)	1.32	(0.76 - 2.29)	0.73	(0.48 - 1.12)	0.94	(0.52 - 1.71)
Turkey	0.80	(0.49 - 1.31)	0.73	(0.24 - 2.28)	0.64	(0.33 - 1.23)	1.06	(0.44 - 2.54)
Morocco	0.45	(0.29 - 0.69)	0.00	(0.00 - 0.00)	0.37	(0.21 - 0.65)	1.34	(0.74 - 2.42)
	breast cancer				**infectious & parasitic diseases**			
			N=2709		N=714		N=257	
other			0.65	(0.49 - 0.87)	2.43	(1.78 - 3.31)	1.48	(0.76 - 2.89)
sub Sahara Africa			0.76	(0.45 - 1.26)	5.15	(3.65 - 7.27)	19.24	(13.56 - 27.29)
Germany*			0.53	(0.33 - 0.87)	1.16	(0.52 - 2.59)	2.19	(0.90 - 5.33)
Netherlands			0.55	(0.30 - 1.02)	2.66	(1.47 - 4.84)	0.65	(0.09 - 4.66)
France			0.93	(0.71 - 1.21)	2.65	(1.81 - 3.88)	0.23	(0.03 - 1.64)
Italy			0.72	(0.56 - 0.92)	1.34	(0.93 - 1.94)	0.84	(0.37 - 1.89)
Spain			0.80	(0.55 - 1.16)	1.57	(0.87 - 2.86)	1.18	(0.38 - 3.68)
Turkey			0.07	(0.01 - 0.48)	1.10	(0.45 - 2.65)	0.00	(0.00 - 0.00)
Morocco			0.46	(0.26 - 0.81)	1.25	(0.69 - 2.27)	0.40	(0.06 - 2.85)
	suicide				**traffic**			
	N=3521		N=1308		N=2482		N=701	
other	0.59	(0.46 - 0.75)	0.84	(0.59 - 1.20)	0.64	(0.48 - 0.86)	0.63	(0.36 - 1.09)
sub Sahara Africa	1.04	(0.77 - 1.39)	1.17	(0.71 - 1.92)	0.99	(0.69 - 1.42)	0.79	(0.35 - 1.78)
Germany*	0.91	(0.63 - 1.32)	1.00	(0.59 - 1.70)	0.82	(0.52 - 1.31)	0.67	(0.28 - 1.60)
Netherlands	0.63	(0.39 - 1.03)	0.32	(0.10 - 1.00)	0.66	(0.37 - 1.16)	0.19	(0.03 - 1.37)
France	1.38	(1.11 - 1.71)	0.96	(0.65 - 1.41)	1.18	(0.89 - 1.57)	1.05	(0.63 - 1.76)
Italy	0.40	(0.30 - 0.52)	0.63	(0.44 - 0.92)	0.73	(0.57 - 0.93)	0.84	(0.54 - 1.31)
Spain	0.85	(0.61 - 1.19)	0.83	(0.48 - 1.44)	0.89	(0.60 - 1.32)	0.48	(0.18 - 1.29)
Turkey	0.24	(0.12 - 0.51)	0.33	(0.11 - 1.03)	1.13	(0.76 - 1.70)	0.58	(0.18 - 1.79)
Morocco	0.28	(0.17 - 0.47)	0.13	(0.03 - 0.52)	0.48	(0.30 - 0.76)	0.68	(0.31 - 1.53)
	alcohol							
	N=1308		N=1308					
other	0.86	(0.61 - 1.22)	0.19	(0.06 - 0.60)				
sub Sahara Africa	0.86	(0.48 - 1.57)	0.21	(0.03 - 1.50)				
Germany*	0.89	(0.48 - 1.66)	1.16	(0.55 - 2.45)				
Netherlands	0.12	(0.02 - 0.85)	0.54	(0.13 - 2.17)				
France	1.43	(1.02 - 2.00)	2.69	(1.89 - 3.82)				
Italy	0.69	(0.49 - 0.97)	0.33	(0.15 - 0.73)				
Spain	0.44	(0.21 - 0.93)	0.57	(0.21 - 1.52)				
Turkey	0.12	(0.02 - 0.82)	0.00	(0.00 - 0.00)				
Morocco	0.11	(0.03 - 0.44)	0.18	(0.02 - 1.26)				

Independent Cox regression for males and females, age in years as categorical covariate
Belgian reference group = 1.00
* Luxemburg and Germany together

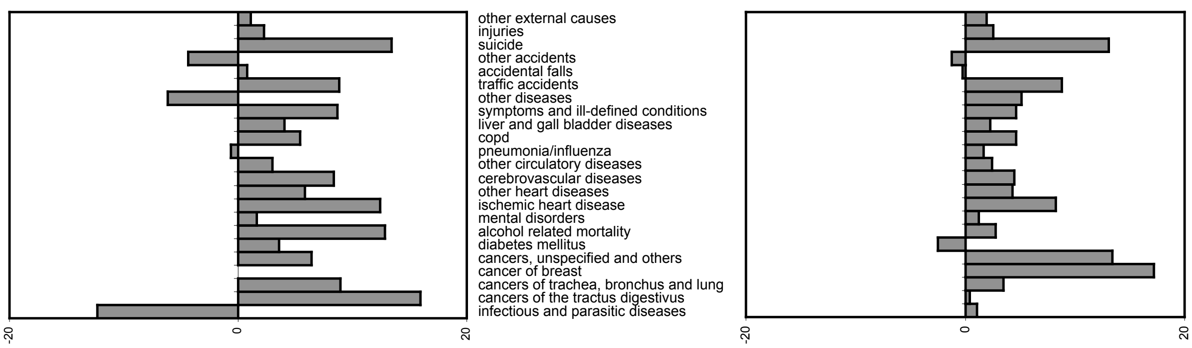
Figure 1: Cause-specific contribution to a higher (*) or a lower (**) total mortality rate of migrant populations compared to the Belgian population
(Belgian total mortality rate at age 25-54, men: 324 per 100,000 – women: 172 per 100,000)

Men *Women*

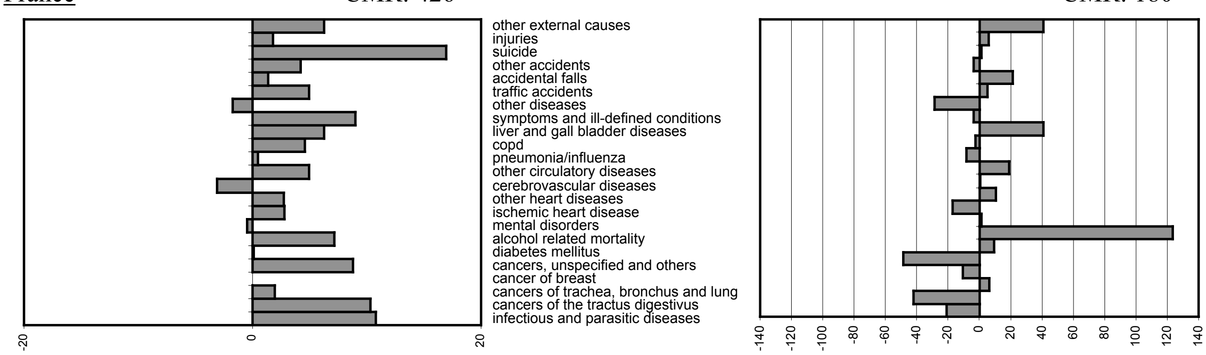
Germany CMR: 314** CMR: 165**



Netherlands CMR: 229** CMR: 100**



France CMR: 426* CMR: 180*



Spain CMR: 266** CMR: 142**

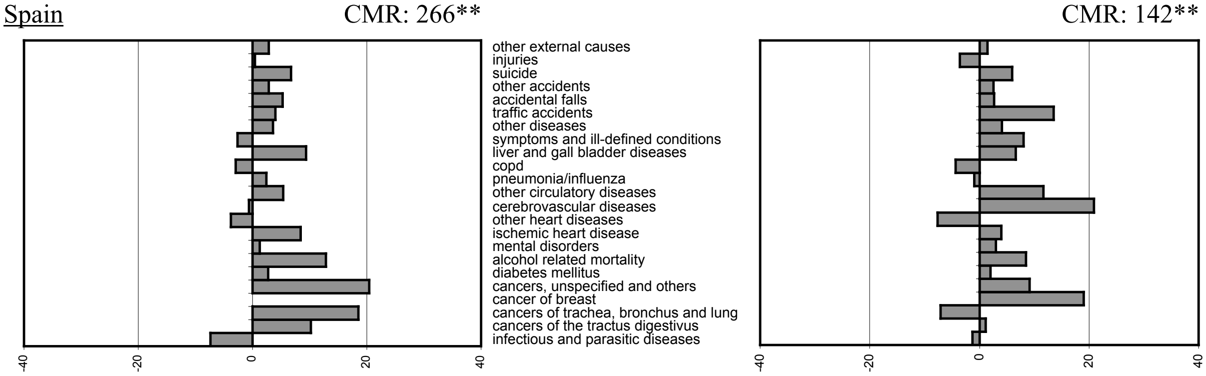
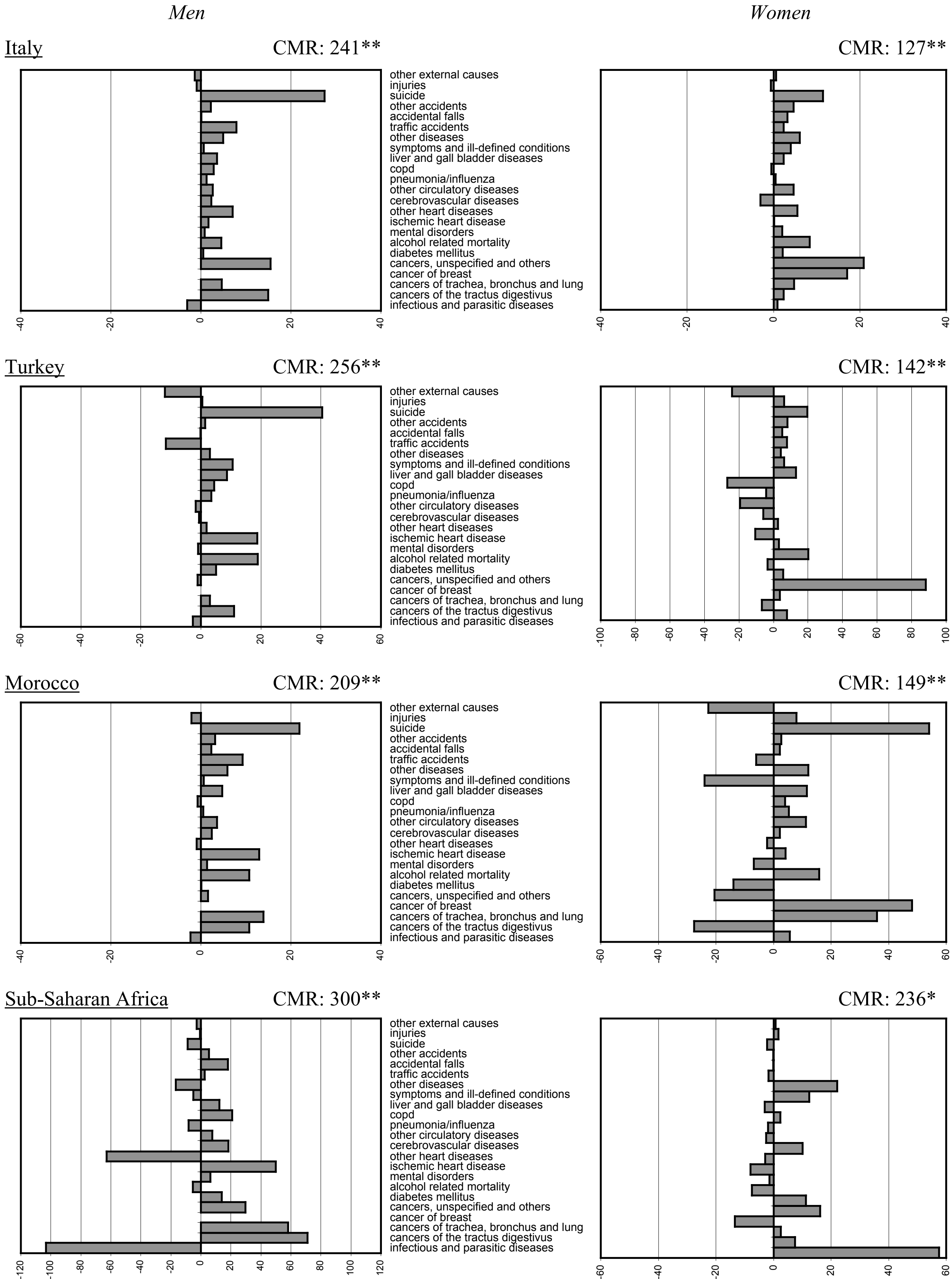


Figure 1: continued



Source: Census 1991, Population Register and Register of Death Certificates

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