Are there differences in injury mortality among refugees and immigrants compared with native-born?

Marie Norredam,1 Maja Olsbjerg,2,3 Jorgen H Petersen,2,3 Bjarne Laursen,3 Allan Krasnik1

ABSTRACT

Background The authors studied injury mortality in Denmark among refugees and immigrants compared with that among native Danes.

Method A register-based, historical prospective cohort design. All refugees (n=29 139) and family reunited immigrants (n=27 134) who between 1 January 1993 and 31 December 1999 received residence permission were included and matched 1:4 on age and sex with native Danes. Civil registration numbers were cross-linked to the Register of Causes of Death, and fatalities due to unintentional and intentional injuries were identified based on ICD-10 diagnosis. Sex-specific mortality ratios were estimated by migrant status and region of birth, adjusting for age and income and using a Cox regression model after a median follow-up of 11–12 years.

Results Compared with native Danes, both female (RR=0.44; 95% CI 0.23 to 0.83) and male (RR=0.40; 95% CI 0.29 to 0.56) refugees as well as female (RR=0.40; 95% CI 0.21 to 0.76) and male (RR=0.22; 95% CI 0.12 to 0.42) immigrants had significantly lower mortality from unintentional injuries. Suicide rates were significantly lower for male refugees (RR=0.38; 95% CI 0.24 to 0.61) and male immigrants (RR=0.24; 95% CI 0.10 to 0.59), whereas their female counterparts showed no significant differences. Only immigrant women had a significantly higher homicide rate (RR=3.09; 95% CI 1.11 to 8.60) compared with native Danes.

Conclusions Overall results were advantageous to migrant groups. Research efforts should concentrate on investigating protective factors among migrants, which may benefit injury prevention in the majority population.

Inequalities in mortality have been documented in several European countries among migrant populations compared with majority populations.4–6 These inequalities vary according to specific causes of death. The few studies investigating injury mortality among migrants in a European context confirm increased mortality for all injuries combined; albeit differences were seen according to type of injury, ethnic group, sex and age.7–9 As in these studies, our definition of injury mortality included mortality from both unintentional and intentional injuries.7–9

Studies of injury mortality among migrants are of interest because it could be assumed that migrants are especially vulnerable in this respect as they experience various risk factors related to injuries and injury mortality due to the inherent trauma of uprooting and the challenges of re-establishing life in a new country: (1) migrants have a higher prevalence of mental disorders compared with native populations;10–12 (2) migrants experience discrimination and hate crimes;13 (3) migrants’ socioeconomic status is often lower compared with native populations;1 (4) migrants more frequently work in unskilled high-risk jobs;16 and (5) migrants experience problems in accessing appropriate healthcare.10–17 These risk factors may alone or in combination result in higher injury mortality; this may especially be the case for vulnerable migrant groups such as refugees. Conversely, migration could hypothetically also be protective in relation to injuries. Building on the healthy migrant theory, one may argue that some migrant groups have a stronger health than native populations.6 Additionally, literature on risk behaviour show less substance abuse among migrants compared with host populations.18

No Nordic studies exist on injury mortality among migrants; however, a Danish study on unintentional injuries found lower injury rates among migrants’ children compared with the children of native Danes.19 The scarcity of studies and the contrasting findings emphasise the need for more knowledge on injury mortality patterns among migrants compared with patterns among native populations. Additionally, existing studies divide populations according to ethnicity (country of origin) rather than migrant status (refugees vs family reunited immigrants).5–9 Consequently, we aimed to determine injury mortality, including both ethnic origin and migrant status, in a well-defined cohort of migrants and compare it with that among native Danes based on national data using the unique Danish possibilities of register-based national data.

Of the population in Denmark in 2010, immigrants and descendants constituted 9.8%, of whom 2.3% were descendants and 7.5% immigrants.1 The majority (61%) of immigrants come from non-Western countries, the five most frequent countries of origin being: Turkey, Iraq, Lebanon, Bosnia and Pakistan. Divided by migrant status, Denmark has received 79 000 refugees and 105 000 family reunited immigrants within the past 15 years.2 3 Refugees enter Denmark as spontaneous asylum seekers or as quota refugees, whereas family reunited immigrants enter Denmark by their own means and rely entirely on their family when establishing life in the country of immigration. In this paper, family reunited immigrants are referred to as ‘immigrants’, while ‘migrants’ refer to all groups of foreign-born individuals.
MATERIAL AND METHODS

Study cohort

The study cohort was obtained through the statistics department at the Danish Immigration Service. All individuals who obtained right of residency as refugees or through family reunification in Denmark from 1 January 1993 to 31 December 1999 were included; 84,379 individuals were identified. The cohort was established on 1 January 1993 as this was the first year for which the Danish Immigration Service had valid registry information on all individuals obtaining residence permit. Next, we excluded individuals <18 years of age (n=18,861) when they obtained residency. Another 3,042 individuals were excluded due to missing civil registration numbers or because their personal security numbers appeared more than once in the sample. Additionally, 15 migrants and their controls were excluded due to problems with their registration of nationality. A Danish-born reference population was identified through Statistics Denmark, and a 4:1 match on an individual level on age and sex was performed through a random sampling procedure. We made a 4:1 matching for all refugees. Four of the immigrants were missing from a total of 15 controls due to difficulties with age matching because of outlying ages. The study cohort and matching procedure have previously been described in more detail.20 Last, 6,188 migrants born in Western countries were excluded from the cohort with their corresponding controls. We excluded Western migrants because we expected patterns of injury-related mortality to differ from non-Western migrants due to differences in exposures to risk factors related to migration processes between these two groups. The final cohort comprised 29,139 refugees (controls: 116,556) and 27,134 immigrants (controls: 108,534). Migrants were consecutively censored on their last recorded emigration date and were not included again if they later returned to Denmark. Follow-up time was thus defined for both refugees and immigrants and their corresponding controls as the time from the commencement of right of residency until the time of the first of the following events: (a) date of death; (b) end of study (31 December 2007); or (c) date of first emigration. Characteristics of the study population are shown in Table 1.

Data collection

Civil registration numbers of the study cohort were cross-linked to the Danish Register on Causes of Death using the personal identification number, which is a unique 10-ciphré number that all Danish citizens receive. The Register on Causes of Death has data based on the report of death certificates to the National Board of Health. The register was updated to 31 December 2007. Death causes were coded according to the International Classification of Diseases (ICD), tenth revision. The register has used the ICD-10 coding system since 1 January 1994, a change from the ICD-8 coding system previously used. As the validity of the translations in the register from ICD-8 to ICD-10 is questionable, we decided to use only ICD-10 diagnoses starting from 1 January 1994. Among all deaths (n=98,855) in the cohort, the cause of death was missing in 165 individuals and were consequently excluded from the study on their date of death. We identified all unintentional and intentional injury-related deaths from 1 January 1994 to 31 December 2007. Unintentional injuries included injuries with undetermined intent, meaning that in some cases it is not known from the record whether an individual died from accidental or by suicide (eg, in some cases of drowning). Unintentional injuries encompassed: falls (W00-W19); traffic injuries (V01-V89); unintentional poisoning - not medication (X40-X49); and other causes (V90-V94, Y60-Y84, Y88, V95-V99, W20-W64, W75-99, X00-X39, X50-X59, Y40-Y59, Y86). Intentional injuries included: all suicides (X60-X84, Y87.0) and homicides (X85-X99, Y00-Y09, Y87.1). This definition of injury mortality is in line with a previous Danish study.21 The cohort comprised 92 refugee (control: 598) and 48 immigrant (control: 577) deaths from injuries.

We analysed data by migrant status (refugees vs family reunited immigrants) and adjusted for region of origin according to the largest migrant groups in Denmark. We based our definitions of geographical areas on WHO guidelines: Asia, Eastern Europe, the former Yugoslavia, Iraq, the Middle East, North Africa and Sub-Saharan Africa.22 As Iraqis formed the largest

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**Table 1** Characteristics of the study cohort. Refugees (n=29,139) and immigrants (27,134) and their matched Danish-born control groups are distributed by sex

<table>
<thead>
<tr>
<th>Regional of origin</th>
<th>Female refugees % (n)</th>
<th>Male refugees % (n)</th>
<th>Female immigrants % (n)</th>
<th>Male immigrants % (n)</th>
<th>Female Danes % (n)</th>
<th>Male Danes % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>1.8 (238)</td>
<td>3.1 (509)</td>
<td>27.3 (4996)</td>
<td>10.8 (955)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Europe</td>
<td>2.0 (258)</td>
<td>1.8 (297)</td>
<td>16.8 (3100)</td>
<td>5.4 (481)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Former Yugoslavia</td>
<td>57.2 (7404)</td>
<td>49.2 (7965)</td>
<td>5.7 (1038)</td>
<td>9.8 (858)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iraq</td>
<td>11.3 (1464)</td>
<td>19.5 (3154)</td>
<td>6.5 (1185)</td>
<td>2.0 (180)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle East</td>
<td>10.3 (1329)</td>
<td>10.0 (1625)</td>
<td>27.8 (5088)</td>
<td>47.3 (4140)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Africa</td>
<td>15.7 (2031)</td>
<td>14.5 (2335)</td>
<td>9.8 (1826)</td>
<td>15.0 (1322)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>1.7 (225)</td>
<td>1.9 (305)</td>
<td>6.1 (1121)</td>
<td>9.7 (846)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100 (12949)</td>
<td>100 (51796)</td>
<td>100 (64760)</td>
<td>100 (7870)</td>
<td>100 (35118)</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>44.4 (12949)</td>
<td>44.4 (51796)</td>
<td>55.6 (64760)</td>
<td>67.6 (73416)</td>
<td>32.4 (35118)</td>
<td></td>
</tr>
</tbody>
</table>

**Events during follow-up**

| Total deaths | 3.7 (481) | 4.7 (2451) | 0.9 (1411) | 1.6 (143) | 3.3 (1164) |
| Emigrations   | 13.6 (1765) | 3.8 (1977) | 14.3 (2324) | 17.6 (3222) | 6.0 (4458) | 22.9 (2017) | 6.6 (2333) |
| Population at closure | 83.0 (10703) | 91.5 (47368) | 81.7 (13209) | 88.8 (58171) | 81.5 (14961) | 92.1 (67547) | 75.4 (6620) | 90.1 (31621) |
| Median age at entry 21 December 1999 | 33.1 (26,542) | 33.1 (26,542) | 32.7 (26,441) | 26.6 (22,331) | 26.6 (22,331) | 27.0 (23,325) | 27.0 (23,324) |
| Median age at study end 31 December 2007 | 44.3 (37,542) | 44.7 (37,545) | 43.5 (37,052) | 43.9 (37,652) | 36.8 (32,143) | 37.5 (32,844) | 36.9 (32,842) | 37.8 (33,843) |
| Median follow-up in years | 12.1 (10.3,12.4) | 12.1 (10.7,12.5) | 11.9 (9.7,12.4) | 12.1 (10.5,12.5) | 10.8 (9.0,12.4) | 10.9 (9.2,12.6) | 10.5 (9.0,12.2) | 10.8 (9.2,12.4) |
group of individuals from the Middle East we decided to define them as a separate group. Moreover, we excluded the former Yugoslavia from Eastern Europe because individuals from the Balkan in the 1990s mainly came due to the war rendering them a special group. Data on income were obtained from Statistics Denmark. The variable on income is updated annually on 31 December. Personal income was divided into three categories: low (<€13.500/year), middle (€13.500–40.500/year) and high (>€40.500/year). In total, 848 individuals, 113 refugees (controls: 224) and 368 immigrants (controls: 143) did not have a registered income by 31 December 2007. These individuals were excluded from our analysis, which was consequently based on 29,026 refugees (controls: 116,332) and 26,766 immigrants (controls: 108,591).

Statistical analysis
We estimated the rate ratio (RR) and 95% CIs for refugees and immigrants compared with their Danish-born controls using a Cox regression model (in SAS V9.1), which was fitted separately for men and women. Native Danes form the reference group. The Cox regression analysis implies a continuous adjustment for age in the model. Further, the RR was analysed by both migrant status, region of birth and adjusted for income. The analyses take into consideration the time during which an individual has been in a certain income category and allow for people to change from one income category to another over time. We assumed that the effect of income on mortality was the same for refugees, immigrants and controls. Before making this assumption we analysed all interactions among migrant status, region of birth and income and found no significant interactions. First, we studied the unadjusted RR and then the RR adjusted for income. As these separate analyses gave the same conclusion, table 2 shows only the adjusted rates. Further, analyses split on region of origin are referred to only in the text. The Cox regression model allowed us to compare the RR for refugees with that of immigrants, and not only with that of their Danish-born controls. Last, because of the low number of homicides and suicides, only unintentional injuries are described by specific cause of injury and differences are tested using \( \chi^2 \) tests (table 3).

The Danish Data Protection Agency has approved the study. Further, ethical approval regarding registry-based research is not required in Denmark.23 The data set was made available and analysed in an anonymous form by remote online access to the data set stored at Statistics Denmark.

RESULTS
Table 1 shows characteristics of the study cohort distributed by migrant status and sex. The cohort had a median age at study end of around 44 years among refugees and 37 years among immigrants. The median follow-up time was approximately 12 years for refugees and approximately 11 years for immigrants. Among refugees, 44% were women, and among immigrants 67% were women. Approximately half the refugees in the cohort came from the former Yugoslavia, while immigrants originated mainly from the Middle East and Asia.

Table 2 shows the RR of sex-specific injury mortality estimated by migrant status, adjusted for age and income. Compared with native Danes, suicide mortality was significantly lower for male refugees (RR = 0.38; 95% CI 0.24 to 0.61) and male immigrants (RR = 0.24; 95% CI 0.10 to 0.59), whereas female refugees (RR = 0.80; 95% CI 0.40 to 1.61) and female immigrants (RR = 0.87; 95% CI 0.46 to 1.65) showed no significant differences. Analysed by region of origin (data not shown in table), suicide mortality was significantly lower for refugee men from the former Yugoslavia (RR = 0.54; 95% CI 0.31 to 0.94) and Iraq (RR = 0.11; 95% CI 0.01 to 0.75) as well as for immigrant men from the Middle East (RR = 0.22; 95% CI 0.05 to 0.87); the results for all other groups were non-significant.

Last, table 2 shows the RR of mortality from unintentional injuries. Compared with native Danes, both female (RR = 0.44; 95% CI 0.23 to 0.85) and male (RR = 0.40; 95% CI 0.29 to 0.56) refugees had significantly lower mortality from unintentional injuries. This was also true of immigrant women (RR = 0.40; 95% CI 0.21 to 0.76) and men (RR = 0.22; 95% CI 0.12 to 0.42). Analysed by region of origin (data not shown in table), homicide mortality was higher among refugee women from Sub-Saharan Africa (RR = 0.55; 95% CI 1.09 to 67.21), albeit only on a borderline significant level. The results for all other groups were non-significant.

Table 2 shows the frequency distribution of unintentional injury mortality by specific disease causes (ICD-10) among refugees and immigrants compared with their Danish-born controls. Male and female immigrants had higher mortality from falls compared with that among native Danes; no systematic differences were found for refugees. Refugees of both sexes and immigrant women had a higher mortality from traffic

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Table 2  Rate ratio (RR) of sex-specific injury mortality estimated by migrant status, adjusted for age and income. Danish-born controls form the reference group. Analyses are based on data from 1 January 1994 to 31 December 2007

<table>
<thead>
<tr>
<th>Injury type</th>
<th>Refugees</th>
<th>Immigrants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Intentional injuries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suicides Women</td>
<td>0.80</td>
<td>(0.40 to 1.61)</td>
</tr>
<tr>
<td></td>
<td>0.38</td>
<td>(0.24 to 0.61)</td>
</tr>
<tr>
<td>Homicides Women</td>
<td>1.71</td>
<td>(0.38 to 7.77)</td>
</tr>
<tr>
<td></td>
<td>2.03</td>
<td>(0.87 to 4.71)</td>
</tr>
<tr>
<td>Unintentional injuries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suicides Men</td>
<td>0.44</td>
<td>(0.23 to 0.83)</td>
</tr>
<tr>
<td></td>
<td>0.40</td>
<td>(0.29 to 0.56)</td>
</tr>
</tbody>
</table>
unintentional injuries compared with native Danes; no difference was seen for immigrant men. However, mortality from poisoning was consistently lower among all migrant groups compared with that among native Danes. For ‘other death causes’, no systematic differences were observed. Only male refugees differed significantly in the distribution of injury types compared with their Danish-born controls (p=0.05) whereas this was not the case for female refugees (p=0.64). Male (p=0.66) and female (p=0.38) immigrants did not differ significantly compared with their Danish-born controls.

To increase power we combined both sexes where the results pointed insignificantly in the same direction. Consequently, we found an RR of 0.94 (95% CI 0.92 to 1.54; p=0.46) for suicide for refugees combined compared with Danish-born and a homicide RR of 1.95 (95% CI 0.93 to 4.1; p=0.46) for refugees combined compared with Danish-born. Aggregated analyses could not contribute to other conclusions for the remaining analyses of intentional and unintentional mortality data, which is why all analyses are shown separately by sex.

DISCUSSION

Our main results show that compared with native Danes, suicide mortality was significantly lower among male refugees and immigrants, whereas their female counterparts showed no significant differences. However, immigrant women had a significantly higher homicide rate than native Danes did: no other groups showed significant differences. Last, refugees and immigrants of both sexes had lower mortality from unintentional injuries compared with native Danes. Differences by region of origin were found for both intentional and unintentional mortality outcomes.

Methodological strengths and limitations

We used the unique Danish possibilities of cross-linkage between several different national registers. This enabled us to identify a large cohort of refugees and family reunited immigrants based on specific information from the immigration authorities on migrant type and also enabled us to divide refugees and immigrants according to seven geographical subgroups. The design allowed us to calculate death rates over a follow-up period of up to 12 years and enabled us to compare directly with a matched group of native Danes.

There are several factors that may have influenced the results of this study. First, it is important to stress the exploratory nature of the study due to the small numbers. Although the study is based on a relatively large cohort of migrants, absolute numbers become relatively small when the specific injury mortalities are investigated and stratified according to region of birth and migrants status. Despite this power problem, our analyses were significant. However, further analysis according to causes of unintentional injuries was only possible in the form of a frequency distribution (table 3). Second, the Register on Causes of Death did not receive death certificates for 3%–4% of all the annual deaths that were registered in the Population Register at Statistics Denmark. Third, 1.7% (168/9,985) of all deaths studied for cause-specific mortality had ‘unknown’ cause of death listed. Consequently, there may be differences between migrants and native Danes regarding the distribution of these unknown death causes, but these differences are not likely to be substantial as the 168 deaths are fairly equally distributed over migrants and controls. Last, our results may also have been affected by registered or unregistered remigration, which would have skewed the denominator figures. Thus, remigration of healthy individuals may have inflated our results, whereas remigration of critically ill individuals with infectious diseases who then die abroad would have led to an underestimation (the so-called ‘remigration bias’). We had no means of taking these biases into consideration as we did not know the extent of remigration in relation to these two points. Deaths abroad of individuals with a Danish personal identification number are not reported to the Danish authorities on an irregular basis. Those death certificates sent to the Register of Death Causes are not included due to validity problems.

Discussion of findings

Our results showed a protective effect of being a migrant on suicide mortality, albeit only significantly so for men. Although the results are based on very small numbers, they are supported by some European studies.8 21 24 But in contrast to others.25 For example, a Danish study showed that male residents with foreign citizenship in Denmark had a lower risk of suicide compared with male Danish citizens.26 These results are contra-intuitive in that research has established higher rates of mental health problems among migrants of both sexes, which is explained by the strain of trauma, prolonged asylum procedures, loss of identity and the stress of re-establishing life in the immigration country.10–12 Additionally, rates of suicidal behaviour are higher among migrants than among natives.27 28 What could explain our results? Studies show that some non-Western migrants have stronger cultural and religious norms, which make suicide-selection less acceptable and therefore discourages individuals despite mental health problems.29 30 Our study enabled us to divide by migrant status, and previous studies of our cohort have indeed shown more mental disorders among refugees compared with family reunited immigrants.9 31 Contrary to our expectations, we found only a minor protective effect of family reunification compared with refugee status.
Second, our results showed non-significant tendencies towards a higher mortality from homicide among immigrant women. Our findings are based on very small numbers, which warrants caution when interpreting them. Two Dutch studies also found a higher homicide rate among migrants of both sexes compared with native Dutch. 7,8 A higher mortality from homicide among migrants may be attributed to several interrelated factors, including the psychosocial stress of re-establishing life in a new context, lower socioeconomic position, differences in cultural norms and higher involvement in criminal affairs among migrants. A recent Danish study showed that male first-generation migrants and descendants from non-Western countries had a higher involvement in all criminal activities compared with that among native Danes with a similar socioeconomic background. 32

Finally, our results showed consistently lower rates of unintentional injury mortality among all groups of migrants compared with that among the Danish-born. This is supported by a Danish study on unintentional injuries that found lower rates of injuries treated at emergency departments among migrants’ children compared with children of native Danes. 19

The literature shows that unintentional injury mortality differs according to unintentional injury type. 7–9 We preformed an analysis of the causes of unintentional injuries to understand our results better; however, due to small numbers we could only make a $\chi^2$ test frequency distribution. The only significant finding was differences between male refugees and Danish-born. Male refugees died more from traffic injuries whereas Danish-born especially died more from poisoning, including poisoning from medicine, drugs and alcohol. These results are supported by the literature on risk behaviour, which shows low alcohol and drug consumption among migrants compared with the host populations. 18,33

In conclusion, our study is exploratory in nature being limited by numbers; however, the results suggest interesting trends in injury-related mortality. Overall results were advantageous to migrant groups, apart from homicide mortality. Future research needs to further explore injury patterns in larger populations also using less severe injury outcomes. Moreover, research including qualitative studies should concentrate on investigating which protective factors are important among migrants compared with natives. Such research may also benefit injury prevention in the majority population.

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Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

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REFERENCES
Inflatable bounce house injuries

A report in Pediatrics shows that a design overhaul of children’s inflatable bounce houses is needed because about 30 children per day in the USA are injured while playing in them. Between 1995 and 2010 there was a 15-fold increase in the number of such injuries especially in recent years. The U.S. Consumer Product Safety Commission recommends that children under 6 not be allowed to use full-size bounce houses. The authors, headed by Gary Smith, called for better guidelines for use and for design changes.

Record low homicides in New York

Murders in New York City have dropped to their lowest level in over 40 years. The actual number is 414 homicides in 2012, compared with 515 for 2011. In the 1990s the totals were in the 2000s. The Mayor credited the department’s controversial practice of stopping people on the street and questioning them as well as aggressive hot-spot policing. Against this good news is the fact that 20 children were murdered. Nevertheless, total killings have dropped so low that there are now more suicides than homicides. The commissioner said ‘he believed that relatively new policing strategies, including adding more police officers dedicated to curbing domestic violence, and monitoring social media to thwart gang-related murders, were working.’

Magnets banned

An Australian report states that small, high powered magnets that can cause serious injury or death if swallowed by children have been permanently banned. The products that contain numerous small, high-powered magnets are marketed as toys, games or puzzles. The problem is ‘If a young child swallows more than one of these high-powered magnets they can attract to each other across the intestinal wall and perforate the intestine, leading to serious injury or possibly death. Teenagers have also needed surgery after using these magnets to imitate mouth or tongue piercings.’

From Richard Hockey