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Heart failure in immigrant groups: a cohort study of adults aged 45 years and over in Sweden

Per Wändell[1,*], **Axel C Carlsson**[1], **Xinjun Li**[2], **Danijela Gasevic**[3,4], **Johan Ärnlöv**[1,5], **Martin J Holzmann**[6,7], **Jan Sundquist**[2,8,9], and **Kristina Sundquist**[2,8,9]

[1]Division of Family Medicine and Primary Care, Department of Neurobiology, Care Sciences and Society, Karolinska Institutet, Huddinge, Sweden

[2]Center for Primary Health Care Research, Lund University, Malmö, Sweden

[3]Usher Institute of Population Health Sciences and Informatics, College of Medicine and Veterinary Medicine, University of Edinburgh, Edinburgh, UK

[4]School of Public Health and Preventive Medicine, Monash University, Melbourne, Australia

[5]School of Health and Social Studies, Dalarna University, Falun, Sweden

[6]Functional Area of Emergency Medicine, Karolinska University Hospital, Stockholm, Sweden

[7]Department of Internal Medicine Solna, Karolinska Institutet, Stockholm, Sweden

[8]Department of Family Medicine and Community Health, Department of Population Health Science and Policy, Icahn School of Medicine at Mount Sinai, New York, USA

[9]Center for Community-based Healthcare Research and Education (CoHRE), Department of Functional Pathology, School of Medicine, Shimane University, Japan

Abstract

Objective: An increased risk of being diagnosed with coronary heart disease or atrial fibrillation has been shown among different immigrant groups. However, less is known on the risk of being diagnosed with congestive heart failure (CHF).

Design: We studied CHF in immigrants including all adults ≥ 45 years in Sweden (n=3,274,119) from 1998 to 2012. CHF was defined as at the first event registered in the National Patient Register. Risk of incident CHF in immigrant groups compared to the Swedish-born population was assessed by Cox regression, stratified by sex, adjusting for age, socio-demographic status, and co-morbidities.

Results: During a mean follow-up of 14 years in total, a total of 302,340 (9.2%) events of CHF were registered. We found the following: higher incidence in men from Bosnia, Iraq, Lebanon, Russia and Africa; among women from Bosnia, Iraq, Lebanon, Turkey, Central Europe and Finland; lower incidence in men from Iceland, Latin America, Southern Europe, Norway and

[*]Corresponding author Address: Division of Family Medicine, Dept. NVS, Karolinska Institutet, Alfred Nobels Allé 12, S-141 83 Huddinge, Sweden, Phone: +46-8-52488708, per.wandell@ki.se.

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Western Europe; and among women from Iceland, Southern Europe, Norway, Denmark and Western Europe.

Conclusion: It is important to be aware of the increased incidence of CHF in some immigrant groups, especially from countries and areas where the immigrants have been refugees, in order to enable for a timely diagnosis, treatment of and prevention of CHF and its debilitating complications.

Keywords

Congestive heart failure; first generation immigrants; gender; neighborhood; second generation immigrants; socio-economic status

1. Introduction

Congestive heart failure (CHF) is a leading cause of morbidity, hospitalizations, disability, and death [1], with a large symptom burden and consequent poor quality of life [2]. The prevalence and incidence of CHF increase with age and the cost of care and treatment of CHF constitute a considerable burden on health care [1]. In Sweden, the prevalence of CHF is estimated to be around 2% although incidence and mortality seem to have been decreasing in recent years [3].

A diagnosis of CHF requires three criteria to be fulfilled: typical clinical symptoms such as dyspnea, clinical signs observed via physical examination, and objective findings of impaired cardiac function on echocardiography, chest radiography or other imaging [4]. CHF may be classified as systolic (heart failure with reduced ejection fraction, HFrEF) or diastolic (heart failure with preserved ejection fraction, HFpEF). However, CHF with preserved systolic ejection fraction is more common among the elderly and in women [5] Furthermore, the diagnosis of CHF can be difficult, especially the diagnosis of HFpEF, when objective diagnostic criteria other than ejection fraction are not used as symptoms and signs are not specific [4]. The epidemiology of CHF is likely to have changed during recent years, possibly due to changes in demography and treatment and control of contributing risk factors (e.g. hypertension and ischemic heart disease), as well as to changes in diagnostic criteria of CHF and in the survival rate among prevalent cases [1]. However, the contribution of immigration to the changed pattern of CHF in recent years is largely unknown.

Migration worldwide is increasing, and, today, about 17% of the registered Swedish population is foreign-born compared to only 9% in 1990 (data from Statistics Sweden) [6].

It has been observed that disorders and risk factors for CHF differ among various ethnic and immigrant groups, e.g. a higher risk has been found among south Asians in the UK and Canada [7, 8]. In Chinese immigrants, hypertension is a more prevalent risk factor with a larger proportion of diastolic CHF [8], while African-Americans have a higher rate of coronary heart disease (CHD) [8]. CHD has been found to be increased in many immigrant groups in Sweden compared to the Swedish-born population [9], while hypertension is more common among Finnish immigrants but less common among non-European immigrants [10]. Diabetes mellitus type 2 rates are increased among immigrants from non-European countries compared to the indigenous population in the Nordic countries [11], and overweight and obesity is higher in many immigrant groups compared to the Swedish-born population, especially among women [12]. Thus, the prevalence of CHF may vary between different immigrant groups.

The presence of CHF among immigrant groups in southern Sweden has been previously studied by Borne et al.; an increased risk was found in some groups, such as Finland, former Yugoslavia and Hungary [13], i.e. immigrants from European countries. However, immigrants from non-European countries were under-represented in this study. Given the continuous increase in immigration of individuals from non-European countries to Sweden and other high-income European countries, it is vital that presence of CHF among non-European immigrant groups is also thoroughly explored to help guide prevention and early diagnosis of CHF among these immigrant groups. In addition, we are not aware of any large-scale study of CHF concerning second-generation immigrants in Sweden. Second generation studies are important as the second generation immigrants may be closer to the native population due to a higher degree of acculturation, i.e. social, psychological, and cultural changes that stem from blending between cultures.

The aim of the present study was to explore the incidence of CHF among different groups of first- and second-generation immigrants in Sweden, and to examine whether the incidence differs from the Swedish-born population. We hypothesized that there would be an increased incidence of CHF in certain first and second generation immigrant groups thus mirroring the heart failure risk factor pattern in certain immigrant groups.

2. Methods

2.1 Design

Data used in this study were constructed as a national dataset that contains information on the entire population of Sweden since 1987. This dataset was based on several Swedish registers and contained comprehensive nationwide individual-level data as well as data on neighborhood socio-economic status (SES). The registers used in the present study were the Swedish Total Population Register and the National Patient Register. Sweden's nationwide population and health care registers have exceptionally high completeness and validity [14]. Individuals were tracked using the personal identification numbers, which are assigned to each permanent resident of Sweden upon birth or immigration to the country. These identification numbers were replaced with serial numbers to ensure anonymity. The follow-up period ran from January 1, 1998 until hospitalization/out-patient treatment of CHF at age of diagnosis of 45 years or more, death, emigration or the end of the study period on December 31, 2012, whichever came first.

2.2 Study population and co-morbidities

As CHF in young individuals is rare and has a different risk factor pattern than among older individuals [1], the study population was restricted to those individuals in the Swedish population aged 45 years and older. Country of birth was registered, and the present study was based on analyses of 10 regions (Nordic countries, Southern Europe, Western Europe, Eastern Europe, Baltic countries, Central Europe, Africa, North America, Latin America, and Asia) comprising 27 countries. Countries with less than 10 observed cases of CHF were not analyzed separately. First-generation immigrants (n=434440), who were born outside Sweden, were compared to Swedish-born individuals. Second-generation immigrants (n=121414) were defined as individuals born in Sweden with at least one foreign-born parent, and they were compared to individuals born in Sweden with two Swedish-born parents [15].

Patients with diagnosed CHF were identified by the presence of the ICD-10 code (10th version of the WHO's International Classification of Diseases) for CHF (I50, and I11.0) in the National Patient Register. CHF diagnosed before 1998, i.e. during the years 1987–1997 (according to ICD-9 1987–1996 and ICD-10 1997) were excluded. We also identified co-morbidities according to ICD-10 for the following diagnoses: atrial fibrillation I48, hypertension I10-I19, cardiomyopathy I42-I43, chronic rheumatic heart disease I05-I09, valvular disease I34-I39, CHD I20-I25, stroke I60-I69, diabetes E10-E14, obesity E65-E68, and chronic obstructive pulmonary disease (COPD) J40-J47.

2.3 Outcome variable

Time was calculated from January 1, 1998 (when the whole of Sweden started using ICD-10 diagnostic codes) until hospitalization/out-patient treatment of CHF at age of diagnosis of 45 years or more, death, emigration or the end of the study period on December 31, 2012.

2.4 Demographic and socio-economic variables

The population was stratified by sex. *Age* was used as a continuous variable in the analysis. *Educational attainment* was categorized as ≤9 years (partial or complete compulsory schooling), 10–12 years (partial or complete secondary schooling) and >12 years (attendance at college and/or university). *Geographic region of residence* was included in order to adjust for possible regional differences in hospital admissions and was categorized as: (1) large cities, (2) southern Sweden and (3) northern Sweden. Large cities were defined as municipalities with a population of >200,000 and comprised the three largest cities in Sweden: Stockholm, Gothenburg and Malmö.

2.5 Neighborhood socio-economic status

The neighborhoods were derived from Small Area Market Statistics (SAMS). The average population in each SAMS neighborhood is approximately 2000 people for Stockholm and 1000 people for the rest of Sweden. A summary index was calculated to characterize neighborhood-level deprivation. The neighborhood index was based on information about female and male residents aged 20 to 64 years because this age group represents those who are among the most socioeconomically active in the population (i.e. a group that has a stronger impact on the socioeconomic structure in the neighborhood compared to children, younger women and men, and retirees). The index was based on the following four variables: low educational status (<10 years of formal education); income from all sources, including interest and dividends, that is <50% of the median individual income); unemployment (excluding full-time students, those completing military service, and early retirees); and receipt of social welfare. The index was categorized into three groups: more than one standard deviation (SD) below the mean (high SES or low deprivation level), more than one SD above the mean (low SES or high deprivation level), and within one SD of the mean (middle SES or middle deprivation level), [16] with neighborhood status classified as high, middle or low SES, corresponding to the categories low, middle and high deprivation in the index [17].

2.6 Statistical analysis

Number of cases of CHF was presented for first- and second-generation immigrants and across baseline subject characteristics. Cox regression analysis was used for estimating the risk of incident CHF in different immigrant groups compared to the Swedish-born population. All analyses were stratified by sex. Three models were used: Model 1 was adjusted for age and region of residence in Sweden; Model 2 was adjusted for age, region of residence in Sweden, educational level, marital status and neighborhood SES; Model 3 was constructed as Model 2 with inclusion of co-morbidities. In addition, Cox regression sensitivity analyses were performed in which we excluded first-generation immigrants that had moved to Sweden within the last five years of follow-up. All models were adjusted for age, region of residence in Sweden, educational level, marital status, and neighborhood SES.

We also estimated the adjusted population attributable fraction (PAF), or population attributable risk (PAR) in percent for risk factors, as prevalence (%) among cases multiplied by HR-1/HR [18], using adjusted HRs for the different factors. PAF is useful in order to compare the effect of different risk factors on the incidence of the outcome, in this case of CHF.

The study was approved by the regional ethics boards at Karolinska Institutet and Lund University.

3. Results

Table 1 shows the characteristics of the included samples in the first- and second-generation analyses of Swedish-born and foreign-born individuals 45 years of age and above. In the first-generation analyses, there were 302,340 CHF events (9.2%) and, in the second-generation analyses, there were 66,632 (3.5%) CHF events, during 15 years of follow-up. Overall, CHF was less common among immigrants in general compared to the Swedish-born population, and also among females, individuals with a higher level of formal education, married individuals, and people living in northern Sweden. CHF was more common among individuals with co-morbidities, especially cardiovascular co-morbidities.

Tables 2a and 2b show the incidence of CHF in first generation male and female immigrants, respectively, compared to their Swedish-born counterparts. In the fully adjusted models, and compared to Swedish-born men, the incidence of CHF was higher among male immigrants with origins from Russia, Eastern Europe (especially from Bosnia), Africa, and Asia (especially from Iraq and Lebanon). In contrast, compared to Swedish-born men, the incidence of CHF was lower in men originating from Iceland, Norway, Southern Europe, Western Europe and Latin America, with especially low HRs (≤0.60) for CHF observed among immigrant men from Iceland and Bulgaria. Compared to Swedish-born women, the incidence of CHF was higher among immigrant women from Finland, Bosnia and other parts of former Yugoslavia, Central Europe, and Asia (except for Iran); while a lower incidence of CHF was observed among immigrant women from Denmark, Norway, Southern Europe and Western Europe; with especially low incidence of CHF noted (HRs ≤0.60) among women from Iceland.

The results of the sensitivity analyses performed on the sample of first-generation immigrants, where people who immigrated to Sweden in the five most recent years were excluded, confirmed the results from Tables 2a and 2b.

We also studied the effect of the different background co-morbidities for Swedish-born and first-generation foreign-born subjects (Supplementary Tables 1a and 1b), with adjustment for age and all included variables. The highest PAFs were found for CHD (Swedish-born men 36.4%, foreign-born men 46.3%, Swedish-born women 27.6%, foreign-born men 33.8%) and AF (Swedish-born men 28.0%, foreign-born men 25.8%, Swedish-born women 26.4%, foreign-born men 28.6%), and fairly high PAFs also for COPD (Swedish-born men 8.1%, foreign-born men 11.4%, Swedish-born women 9.4%, foreign-born men 12.0%) and diabetes (Swedish-born men 8.4%, foreign-born men 12.9%, Swedish-born women 7.9%, foreign-born men 12.9%).

We also analyzed immigrant groups with the highest and lowest HRs of incident CHF, respectively. Regarding high risk groups, we grouped men from Bosnia, Iraq and Lebanon together; PAF for CHD was higher than among all foreign-born men, 57.3% vs 46.3%, and for diabetes 16.6% vs 8.9%, while PAF for AF was lower, 19.8% vs 25.8%. Similarly, we grouped women from Bosnia, Iraq, Lebanon and Turkey together; PAF for CHD was higher than among all foreign-born women, 40.9% vs 33.8%, for diabetes 23.6% vs 12.9%, and for hypertension 12.5% vs 5.3%, while AF was lower, 21.6% vs 28.6%. Regarding low risk groups, we examined men and women from southern Europe and Latin-America, respectively. Regarding men from southern Europe and Latin-America, PAF for CHD was 48.7% and 48.5%, AF 27.6% and 26.7%, diabetes 20.3% and 20.5%, hypertension 15.0% and 5.8%, and COPD 14.2% and 8.2%. As regards women from southern Europe and Latin-America, PAF for CHD was 44.2% and 34.6%, AF 26.5 and 32.2%, diabetes 17.3% and 16.0%, hypertension 12.0% and 13.8%, COPD 11.6% and 12.7%.

Furthermore, we analyzed data according to refugee status (men 16,816, 7.7%, women 8,861, 4.1%, of all male and female immigrants); countries of origin with the highest rate of refugees exceeding 10% of all immigrants in each respective group were Iraq (men 17.1%, women 10.0%), Bosnia (men 16.9%, women 21.7%) and Iran (men 15.7%, women 17.1%). HRs (95% CI) for incident CHF in fully adjusted models were the following: for male refugees 1.63 (1.52–1.74) and other male immigrants 0.96 (0.94–0.97); and for female refugees 1.63 (1.46–1.83) and other female immigrants 0.98 (0.96–1.00).

As regards second-generation male and female immigrants in comparison to men and women with Swedish-born parents, incidence of CHF in the immigrants was increased in males with parents from Spain, and in female immigrant groups with parents from the former Yugoslavia and Western European countries except in those from the Netherlands, UK, Germany and Austria (Supplementary Tables 2a and 2b). A decreased incidence of CHF in second-generation immigrants was noted among men with parents from Asia, and women with parents from Poland (but only in the fully adjusted model) compared to their Swedish-born counterparts. An especially lower incidence of CHF (with HRs ≤0.60) was observed in men with parents from Asia and women with parents from Poland (but only in the fully adjusted model).

4. Discussion

This study explored the incidence of CHF among first and second-generation immigrant men and women in Sweden. Higher incidence was found among first-generation men and women from regions where refugees have fled from such as Bosnia, and some Middle Eastern countries. For men from Russia and Africa and for women also from Finland and Central Europe, a higher incidence was found. Furthermore, compared to the Swedes, lower incidence of CHF was found in first-generation immigrant men and women from Iceland, Norway, Southern Europe and Western Europe and for men also from Latin America. For second-generation immigrant groups, only a few differences were noted, e.g. a higher incidence among men with parents from Spain and women with parents from former Yugoslavia and some Western European countries, while a lower incidence was noted among men with parents from Asian countries and women with parents from Poland.

We used an exploratory approach as development of diseases in immigrants can be influenced by many factors, such as genetic, socioeconomic, cultural and lifestyle factors in the country of origin, reasons for migration, the migration process, and acculturation in the new home country. Besides, as CHF is more of a disease that occurs in the elderly, it will often take considerable time to develop the condition.

The findings of this study were to some extent similar to those observed in the study that researched the population from southern Sweden only [13]. Namely, we also observed the increased incidence of CHF among immigrants from high-income and middle-income countries, especially among immigrants from European countries such as Finland, former Yugoslavia, and especially Bosnia, and Hungary. However, by including the entire population of Sweden, our study expands on the findings of the previous study by reporting novel findings on differences in incidence of CHF between immigrants to Sweden and Swedish-born individuals. One important finding is the higher incidence among refugees with origin from countries such as Bosnia and Middle East countries. When looking at disease patterns among CHF patients in immigrants compared to the Swedish-born population, the symptoms are quite similar [19], and only a few differences are described, i.e. a larger presence of ischemic heart disease [20].

Moreover, the AF prevalence in Sweden seems to be especially high, i.e. 3% among people 20 years of age and older [21] compared to 2% in Europe in general [22]. In an earlier study, we found AF to be more common in males and females from Bosnia, and females from Iraq than in Swedish-born individuals [23]. Among immigrants from most other countries and regions, the incidence of AF was lower than that among Swedish-born individuals, and especially low among immigrants from Iceland and Southern Europe.

Hypertension is the most established risk factor for CHF worldwide; however CHD seems to be of higher importance in high-income Western and other European countries, of intermediate importance in East Asia and Latin America, but of lower importance in Sub-Saharan Africa [24], even if the highest blood pressure levels during the last decades have shifted from high-income countries to low-income countries in, for example, South Asia and Sub-Saharan Africa [25]. In general, we found the effect of hypertension to be low. However, we had access to hospital data (most patients with hypertension seek care in primary health care [26]), hence why the effect of hypertension on incident CHF could be under-estimated.

In contrast to hypertension, the prevalence of diabetes mellitus has been shown to be higher especially among female immigrants of Middle Eastern origin than those in the Nordic countries [11]. In fact, the highest prevalence of diabetes was found in the high-risk groups of CHF both among men and women, also with high PAFs. Among the low risk groups, the PAFs were also high even if the overall prevalence of diabetes was similar to that of Swedish-born subjects.

We found modest influence by COPD, with PAF values between 8 and 14%. In contrast, rheumatic heart disease is important in Sub-Saharan Africa and East Asia. In general, the effect of both rheumatic heart disease, cardiomyopathy and valvular heart disease on CHF was rather modest.

CHD has been shown to be more common in many immigrant groups [9], both from European and non-European countries. We found CHD to be the most important factor among both Swedish-born and foreign-born men and women, and with highest PAF among men from Bosnia, Iraq and Lebanon. The findings in the present study correspond well to the increased CHD risk in immigrants from Bosnia and the Middle East. However, our findings concerning a lower incidence of CHF among immigrants from many European countries are in contrast to the increased CHD risk.

One factor of importance for a lower risk of CHF could be the “healthy immigrant effect” [27], i.e. the health of immigrants upon arrival to the new country tends to be better than that of the local-born population. The reason for this “healthy immigrant effect” could be related to different factors. In general, this tends to mean that the healthiest and best educated people, with already established relatively healthy behaviors, tend to migrate to seek better living conditions [28]. The findings of a lower incidence of CHF among many immigrant groups, where similar results have been described for AF incidence, could support this hypothesis [23]. Another possible explanation to the lower incidence of CHF could be that immigrants in general seek care less often due to CHF. However, considering the symptoms of CHF and the effect on health by CHF, it seems unlikely that immigrants seek care to a significantly lower extent than Swedish-born individuals, keeping in mind that Sweden has a universal health care that covers all individuals, irrespective of income or employment status.

Psychosocial stress is another factor of clinical relevance that could be associated with CHF [29]. Subgroups of immigrants, which have been refugees, may have experienced stressful events on different occasions, both before and during the migration, as well as when seeking asylum in the new country. One concept related to stress is allostatic load, i.e. the physiological response to acute stress [30], and also a risk factor for cardiovascular disease [31]. This may be one possible factor contributing to the higher CHF incidence in some groups in the present study, especially among immigrants from Bosnia and Iraq. However, when considering refugee status, with highest rates among immigrants from Bosnia and Iraq, this could contribute to a PAF of below 10%, i.e. a fairly modest risk increase. An alternate explanation to this finding could be that refugees are more prone to be in contact with the health care system, and diseases could be more often and earlier diagnosed than among other groups, even if this seems unlikely, as symptoms of CHF are quite similar in different groups [19].

In addition to the more commonly recognized individual factors, socio-economic factors are also of importance [32, 33]. Both lower family income [34], and lower level of formal education [35] have been shown to increase the incidence of CHF [36]. We also adjusted for neighborhood-level SES as many immigrants, especially those from non-Western countries, live in low SES neighborhoods particularly in the urban areas. Living in low SES neighborhoods in itself has been shown to be associated with incident CHF and CHF outcomes [37]. Differences in healthy lifestyles are important factors to consider behind the increased risk of CVD-related morbidity and mortality, and attitudes and beliefs about these may differ across SES levels [38]. In general, educational level showed a low effect with the exception of highest educational level in the high risk groups, which showed a protective effect.

The CHF risk pattern among second-generation immigrants in most cases differed only marginally compared to their Swedish-born compatriots with two Swedish-born parents, possibly due to acculturation, i.e. they tend to adopt the lifestyle and health patterns of the host population over time and tend to develop CHF at the same rate. However, as most patients with CHF are elderly there could be a power problem in detecting distinct patterns. Similarly, some of the findings are surprising, e.g. the increased incidence among male second-immigrants from Spain in contrast to the decreased incidence among first-immigrants. In fact, rather few individuals were diagnosed in the groups with significantly different estimates compared to the referent population; hence why these findings must be interpreted with great caution.

This study has certain limitations. We had no clinical data on severity of CHF, as well as no results of echocardiography, and could thus not divide into type of CHF, i.e. systolic or diastolic CHF. Besides, the incidence of CHF might seem low. However, prevalent cases, i.e., cases that were present before the start of the study period were excluded, which partly explains the low CHF incidence. We only used cardiovascular co-morbidity as this was in focus for the study, and did not include other diagnoses such as cancer. Furthermore, we did not have access to multiple measures of individual SES, but we had access to level of formal education, which is a commonly used variable [39]. When exploring multiple immigrant groups, as in the present study, there is always a risk of mass significance. In order to manage this, we performed a sensitivity analysis with the exclusion of immigrant subjects from the last five years. Furthermore, the statistical power to detect significant results differed owing to the different sample sizes, with a low statistical power especially among second-generation women. Assessing PAR or PAF can be performed in different ways, and we decided to use the approach proposed by Miettinen [18], as this makes illustrative information fairly easy to interpret. One disadvantage, however, is that if summarizing the PAFs the sum will exceed 100%, which must be kept in mind when interpreting results.

However, the study has many strengths. One key strength is that we were able to link individual clinical data to data from national demographic and socioeconomic registers of high quality. Besides, hospital diagnoses of CHF have earlier been validated in Sweden [40], but in a meta-analysis it was found that the sensitivity of a CHF diagnosis from registers was around 75% [41]. Clinical data were also highly complete [42]. We were also able to analyze data for men and women from different parts of Sweden.

In conclusion, we found an increased incidence of CHF among certain immigrant groups especially among those from Bosnia and the Middle East region, where a higher CHD risk and perhaps also stressful events in refugees could contribute to this increased incidence. A lower CHF incidence was found among other immigrant groups such as in immigrants from Southern Europe and Iceland where a healthy diet could partly explain this finding. From a clinical point of view, it is important to be aware of the increased incidence of CHF in some immigrant groups in order to enable for a timely diagnosis, treatment for prevention of CHF and its debilitating complications.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

[1]. Ziaeian B, Fonarow GC. Epidemiology and aetiology of heart failure. Nat Rev Cardiol 2016;13:368–78. [PubMed: 26935038]

[2]. Alpert CM, Smith MA, Hummel SL, Hummel EK. Symptom burden in heart failure: assessment, impact on outcomes, and management. Heart Fail Rev 2017;22:25–39. [PubMed: 27592330]

[3]. Zarrinkoub R, Wettermark B, Wandell P, Mejhert M, Szulkin R, Ljunggren G, et al. The epidemiology of heart failure, based on data for 2.1 million inhabitants in Sweden. Eur J Heart Fail. 2013;15:995–1002. [PubMed: 23645498]

[4]. Ponikowski P, Voors AA, Anker SD, Bueno H, Cleland JG, Coats AJ, et al. 2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: The Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC). Developed with the special contribution of the Heart Failure Association (HFA) of the ESC. Eur J Heart Fail. 2016;18:891–975. [PubMed: 27207191]

[5]. Garcia M, Mulvagh SL, Bairey Merz CN, Buring JE, Manson JE. Cardiovascular Disease in Women: Clinical Perspectives. Circ Res 2016;118:1273–93. [PubMed: 27081110]

[6]. Statistics Sweden. Foreign-born persons in Sweden by country of birth, age and sex. Year 2000 – 2015 Statistics Sweden; 2016.

[7]. Sosin MD, Bhatia GS, Davis RC, Lip GY. Heart failure--the importance of ethnicity. Eur J Heart Fail. 2004;6:831–43. [PubMed: 15556044]

[8]. Moe GW, Tu J. Heart failure in the ethnic minorities. Curr Opin Cardiol 2010;25:124–30. [PubMed: 20019604]

[9]. Gadd M, Johansson SE, Sundquist J, Wandell P. Morbidity in cardiovascular diseases in immigrants in Sweden. J Intern Med 2003;254:236–43. [PubMed: 12930232]

[10]. Carlsson AC, Wandell PE, de Faire U, Hellenius ML. Prevalence of hypertension in immigrants and Swedish-born individuals, a cross-sectional study of 60-year-old men and women in Sweden. J Hypertens 2008;26:2295–302. [PubMed: 19008708]

[11]. Wandell PE, Carlsson A, Steiner KH. Prevalence of diabetes among immigrants in the Nordic countries. Curr Diabetes Rev 2010;6:126–33. [PubMed: 20201798]

[12]. Wandell PE. Population groups in dietary transition. Food Nutr Res 2013;57.

[13]. Borne Y, Engstrom G, Essen B, Sundquist J, Hedblad B. Country of birth and risk of hospitalization due to heart failure: a Swedish population-based cohort study. Eur J Epidemiol 2011;26:275–83. [PubMed: 21184142]

[14]. Ludvigsson JF, Andersson E, Ekbom A, Feychting M, Kim JL, Reuterwall C, et al. External review and validation of the Swedish national inpatient register. BMC Public Health. 2011;11:450. [PubMed: 21658213]

[15]. White JS, Hamad R, Li X, Basu S, Ohlsson H, Sundquist J, et al. Long-term effects of neighbourhood deprivation on diabetes risk: quasi-experimental evidence from a refugee dispersal policy in Sweden. Lancet Diabetes Endocrinol 2016;4:517–24. [PubMed: 27131930]

[16]. Winkleby M, Sundquist K, Cubbin C. Inequities in CHD incidence and case fatality by neighborhood deprivation. Am J Prev Med 2007;32:97–106. [PubMed: 17234484]

[17]. Zoller B, Li X, Sundquist J, Sundquist K. Neighbourhood deprivation and hospitalization for atrial fibrillation in Sweden. Europace. 2013;15:1119–27. [PubMed: 23447572]

[18]. Miettinen OS. Proportion of disease caused or prevented by a given exposure, trait or intervention. Am J Epidemiol 1974;99:325–32. [PubMed: 4825599]

[19]. Hedemalm A, Schaufelberger M, Ekman I. Symptom recognition and health care seeking among immigrants and native Swedish patients with heart failure. BMC Nurs 2008;7:9. [PubMed: 18590538]

[20]. Hedemalm A, Schaufelberger M, Ekman I. Equality in the care and treatment of immigrants and native Swedes--a comparative study of patients hospitalised for heart failure. Eur J Cardiovasc Nurs 2008;7:222–8. [PubMed: 18032113]

[21]. Friberg L, Bergfeldt L. Atrial fibrillation prevalence revisited. J Intern Med 2013;274:461–8. [PubMed: 23879838]

[22]. Zoni-Berisso M, Lercari F, Carazza T, Domenicucci S. Epidemiology of atrial fibrillation: European perspective. Clin Epidemiol 2014;6:213–20. [PubMed: 24966695]

[23]. Wandell P, Carlsson AC, Li X, Gasevic D, Arnlov J, Holzmann MJ, et al. Atrial fibrillation in immigrant groups: a cohort study of all adults 45 years of age and older in Sweden. Eur J Epidemiol 2017;32:785–96. [PubMed: 28702880]

[24]. Khatibzadeh S, Farzadfar F, Oliver J, Ezzati M, Moran A. Worldwide risk factors for heart failure: a systematic review and pooled analysis. Int J Cardiol 2013;168:1186–94. [PubMed: 23201083]

[25]. Worldwide trends in blood pressure from 1975 to 2015: a pooled analysis of 1479 population-based measurement studies with 19.1 million participants. Lancet. 2017;389:37–55. [PubMed: 27863813]

[26]. Carlsson AC, Wandell P, Osby U, Zarrinkoub R, Wettermark B, Ljunggren G. High prevalence of diagnosis of diabetes, depression, anxiety, hypertension, asthma and COPD in the total population of Stockholm, Sweden - a challenge for public health. BMC Public Health. 2013;13:670. [PubMed: 23866784]

[27]. Kennedy S, Kidd MP, McDonald JT, Biddle N. The Healthy Immigrant Effect: Patterns and Evidence from Four Countries. Int Migration & Integration. 2015;16:317–32.

[28]. Diaz E, Kumar BN. Differential utilization of primary health care services among older immigrants and Norwegians: a register-based comparative study in Norway. BMC Health Serv Res 2014;14:623. [PubMed: 25424647]

[29]. Graff S, Fenger-Grøn M, Christensen B, Søndergaard Pedersen H, Christensen J, Li J, et al. Long-term risk of atrial fibrillation after the death of a partner. Open Heart. 2016;3:e000367. [PubMed: 27099762]

[30]. McEwen BS. Allostasis and allostatic load: implications for neuropsychopharmacology. Neuropsychopharmacology. 2000;22:108–24. [PubMed: 10649824]

[31]. Seeman TE, Singer BH, Rowe JW, Horwitz RI, McEwen BS. Price of adaptation--allostatic load and its health consequences. MacArthur studies of successful aging. Arch Intern Med 1997;157:2259–68. [PubMed: 9343003]

[32]. Diaz-Toro F, Verdejo HE, Castro PF. Socioeconomic Inequalities in Heart Failure. Heart Fail Clin 2015;11:507–13. [PubMed: 26462090]

[33]. Hawkins NM, Jhund PS, McMurray JJ, Capewell S. Heart failure and socioeconomic status: accumulating evidence of inequality. Eur J Heart Fail. 2012;14:138–46. [PubMed: 22253454]

[34]. Fretz A, Schneider AL, McEvoy JW, Hoogeveen R, Ballantyne CM, Coresh J, et al. The Association of Socioeconomic Status With Subclinical Myocardial Damage, Incident Cardiovascular Events, and Mortality in the ARIC Study. Am J Epidemiol 2016;183:452–61. [PubMed: 26861239]

[35]. Christensen S, Mogelvang R, Heitmann M, Prescott E. Level of education and risk of heart failure: a prospective cohort study with echocardiography evaluation. Eur Heart J. 2011;32:450–8. [PubMed: 21147865]

[36]. Harris DE, Aboueissa AM, Hartley D. Myocardial infarction and heart failure hospitalization rates in Maine, USA - variability along the urban-rural continuum. Rural Remote Health. 2008;8:980. [PubMed: 18627216]

[37]. Bikdeli B, Wayda B, Bao H, Ross JS, Xu X, Chaudhry SI, et al. Place of residence and outcomes of patients with heart failure: analysis from the telemonitoring to improve heart failure outcomes trial. Circ Cardiovasc Qual Outcomes. 2014;7:749–56. [PubMed: 25074375]

[38]. Wardle J, Steptoe A. Socioeconomic differences in attitudes and beliefs about healthy lifestyles. J Epidemiol Community Health. 2003;57:440–3. [PubMed: 12775791]

[39]. Winkleby MA, Jatulis DE, Frank E, Fortmann SP. Socioeconomic status and health: how education, income, and occupation contribute to risk factors for cardiovascular disease. Am J Public Health. 1992;82:816–20. [PubMed: 1585961]

[40]. Ingelsson E, Arnlov J, Sundstrom J, Lind L. The validity of a diagnosis of heart failure in a hospital discharge register. Eur J Heart Fail. 2005;7:787–91. [PubMed: 15916919]

[41]. McCormick N, Lacaille D, Bhole V, Avina-Zubieta JA. Validity of heart failure diagnoses in administrative databases: a systematic review and meta-analysis. PLoS One. 2014;9:e104519. [PubMed: 25126761]

[42]. Sundquist K, Chaikiat A, Leon VR, Johansson SE, Sundquist J. Country of birth, socioeconomic factors, and risk factor control in patients with type 2 diabetes: a Swedish study from 25 primary health-care centres. Diabetes Metab Res Rev 2011;27:244–54. [PubMed: 21309045]

Table 1.

The number of incident cases of congestive heart failure (CHF) diagnoses across baseline study characteristics in the Swedish population used to study CHF in first-generation and second-generation immigrants compared to Swedish-born individuals

	First-generation analysis				Second-generation analysis			
	Population		CHF diagnosis		Population		CHF diagnosis	
	No	%	No.	%	No	%	No.	%
Total population	3,274,119		302,340		1,900,129		66,632	
Gender								
Males	1,546,469	47.2	154,195	51.0	957,436	50.4	44,297	66.5
Females	1,727,650	52.8	148,145	49.0	942,693	49.6	22,335	33.5
Country of origin *								
Sweden	2,836,814	86.6	275,921	91.3	1,778,305	93.6	63,357	95.1
Born outside Sweden	437,305	13.4	26,419	8.7	121,824	6.4	3,275	4.9
Birth year								
-1909	76,011	2.3	10,781	3.6				
1910-19	337,792	10.3	80,653	26.7				
1920-29	619,485	18.9	115,927	38.3				
1930-39	730,396	22.3	59,736	19.8	445,829	23.5	31,606	47.4
1940-49	1,092,929	33.4	30,019	9.9	1,038,767	54.7	29,356	44.1
1950-	417,506	12.8	5,224	1.7	415,533	21.9	5,670	8.5
Educational level								
≤ 9	1,539,480	47.0	189,654	62.7	610,021	32.1	29,306	44.0
10-12	82,0604	25.1	61,643	20.4	571,656	30.1	19,317	29.0
> 12	914,035	27.9	51,043	16.9	718,452	37.8	18,009	27.0
Region of residence								
Large cities	1,091,203	33.3	109,355	36.2	645,668	34.0	23,622	35.5
Southern Sweden	1,448,402	44.2	139,837	46.3	873,157	46.0	30,301	45.5
Northern Sweden	73,4514	22.4	53,148	17.6	381,304	20.1	12,709	19.1
Marital status								
Married	2,646,937	80.8	221,529	73.3	1,522,703	80.1	47,203	70.8
Unmarried	62,7182	19.2	80,811	26.7	377,426	19.9	19,429	29.2
Hospital diagnosis of COPD								
No	3,069,202	93.7	252,325	83.5	1,802,075	94.8	53,879	80.9
Yes	204,917	6.3	50,015	16.5	98054	5.2	12,753	19.1
Hospital diagnosis of obesity								
No	3,246,851	99.2	298,022	98.6	1,877,100	98.8	63,643	95.5
Yes	27,268	0.8	4,318	1.4	23,029	1.2	2,989	4.5
Hospital diagnosis of CHD								
No	2,784,138	85.0	153,609	50.8	1,713,499	90.2	34,007	51.0
Yes	489,981	15.0	148,731	49.2	186,630	9.8	32,625	49.0
Hospital diagnosis of diabetes								

	First-generation analysis				Second-generation analysis			
	Population		CHF diagnosis		Population		CHF diagnosis	
	No	%	No.	%	No	%	No.	%
No	2,983,822	91.1	241,667	79.9	1,754,417	92.3	48,599	72.9
Yes	290,297	8.9	60,673	20.1	145,712	7.7	18,033	27.1
Hospital diagnosis of stroke								
No	2,928,212	89.4	236,781	78.3	1,792,149	94.3	55,697	83.6
Yes	345,907	10.6	65,559	21.7	107,980	5.7	10,935	16.4
Hospital diagnosis of hypertension								
No	2,609,163	79.7	198,101	65.5	1,548,525	81.5	36,578	54.9
Yes	664,956	20.3	104,239	34.5	351,604	18.5	30,054	45.1
Hospital diagnosis of chronic rheumatic heart disease								
No	3,267,656	99.8	298,867	98.9	1,897,948	99.9	65,764	98.7
Yes	6,463	0.2	3,473	1.1	2,181	0.1	868	1.3
Hospital diagnosis of atrial fibrillation								
No	2,935,147	89.6	177,650	58.8	1,785,264	94.0	39,652	59.5
Yes	338,972	10.4	124,690	41.2	114,865	6.0	26,980	40.5
Hospital diagnosis of cardiomyopathy								
No	3,255,622	99.4	289,711	95.8	1,887,914	99.4	58,424	87.7
Yes	18,497	0.6	12,629	4.2	12,215	0.6	8,208	12.3
Hospital diagnosis of valvular heart disease								
No	3,184,852	97.3	266,509	88.1	1,865,132	98.2	57,928	86.9
Yes	89,267	2.7	35,831	11.9	34,997	1.8	8,704	13.1
Neighbourhood deprivation								
Low	491,884	15.0	34,335	11.4	338,815	17.8	8,935	13.4
Middle	1,649,788	50.4	164,983	54.6	976,101	51.4	35,238	52.9
High	365,677	11.2	40,903	13.5	195,959	10.3	9,126	13.7
Unknown	766,770	23.4	62,119	20.5	389,254	20.5	13,333	20.0

*: Immigrant status in second generation was based on parental birth country.

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Table 2a.

Incidence (hazard ratio with 95% confidence intervals) of CHF in first-generation male immigrants compared to Swedish-born (based on a total of 1,546,469 individuals)

	Model 1			Model 2			Model 3		
	HR	**95% CI**				**95% CI**	**HR**	**95% CI**	
Sweden	1			1			1		
Nordic countries	**0.92**	**0.90**	**0.95**	0.99	0.96	1.01	0.98	0.95	1.00
Denmark	**0.87**	**0.82**	**0.92**	0.85	0.81	0.90	0.89	0.84	0.94
Finland	0.97	0.94	1.00	1.08	1.05	1.11	1.04	1.01	1.07
Iceland	**0.23**	**0.14**	**0.39**	**0.28**	**0.17**	**0.47**	**0.38**	**0.23**	**0.63**
Norway	**0.84**	**0.79**	**0.90**	**0.89**	**0.83**	**0.95**	**0.87**	**0.81**	**0.93**
Southern Europe	**0.52**	**0.48**	**0.57**	**0.60**	**0.56**	**0.66**	**0.76**	**0.70**	**0.82**
France	**0.59**	**0.46**	**0.77**	**0.73**	**0.56**	**0.95**	0.83	0.64	1.08
Greece	**0.42**	**0.36**	**0.49**	**0.50**	**0.43**	**0.57**	**0.69**	**0.59**	**0.79**
Italy	**0.65**	**0.57**	**0.73**	**0.75**	**0.66**	**0.85**	**0.84**	**0.74**	**0.96**
Spain	**0.52**	**0.41**	**0.65**	**0.62**	**0.49**	**0.77**	**0.78**	**0.62**	**0.98**
Other Southern Europe	**0.39**	**0.28**	**0.56**	**0.38**	**0.27**	**0.54**	**0.56**	**0.39**	**0.80**
Western Europe	**0.76**	**0.72**	**0.80**	**0.87**	**0.82**	**0.91**	**0.90**	**0.86**	**0.95**
The Netherlands	**0.58**	**0.47**	**0.72**	**0.65**	**0.52**	**0.80**	**0.69**	**0.55**	**0.85**
UK and Ireland	**0.43**	**0.36**	**0.52**	**0.53**	**0.44**	**0.64**	**0.70**	**0.58**	**0.83**
Germany	**0.86**	**0.81**	**0.91**	0.96	0.90	1.02	0.96	0.90	1.02
Austria	**0.80**	**0.70**	**0.91**	0.92	0.80	1.05	0.91	0.80	1.04
Other Western Europe	**0.62**	**0.49**	**0.80**	**0.77**	**0.60**	**0.98**	0.84	0.65	1.08
Eastern Europe	1.05	0.99	1.10	1.04	0.99	1.10	**1.14**	**1.08**	**1.20**
Bosnia	**2.15**	**1.88**	**2.46**	**3.23**	**2.83**	**3.70**	**2.38**	**2.08**	**2.72**
Yugoslavia	1.00	0.94	1.07	0.97	0.91	1.03	1.08	1.01	1.15
Croatia	**0.71**	**0.55**	**0.93**	**0.64**	**0.49**	**0.83**	0.85	0.65	1.11
Romania	0.92	0.76	1.11	0.96	0.80	1.17	0.98	0.81	1.19
Bulgaria	**0.48**	**0.31**	**0.75**	**0.53**	**0.34**	**0.83**	**0.59**	**0.38**	**0.93**
Other Eastern Europe	0.79	0.53	1.17	0.65	0.44	0.97	0.88	0.59	1.31
Baltic countries	1.03	0.95	1.11	1.13	1.05	1.23	1.08	1.00	1.17
Estonia	1.00	0.92	1.10	1.11	1.01	1.21	1.07	0.98	1.16
Latvia	1.15	0.96	1.39	1.27	1.05	1.53	1.16	0.96	1.40
Central Europe	1.04	0.98	1.10	**1.08**	**1.02**	**1.15**	**1.05**	**1.00**	**1.12**
Poland	1.08	0.99	1.18	**1.11**	**1.02**	**1.22**	1.08	0.98	1.18
Other Central Europe	0.97	0.86	1.11	1.06	0.93	1.21	1.03	0.91	1.17
Hungary	1.03	0.94	1.13	1.06	0.97	1.16	1.04	0.95	1.14
Africa	**0.84**	**0.74**	**0.96**	0.99	0.88	1.13	**1.22**	**1.08**	**1.39**
Northern America	**0.80**	**0.71**	**0.90**	0.90	0.80	1.01	0.93	0.83	1.05
Latin America	**0.46**	**0.39**	**0.53**	**0.52**	**0.45**	**0.60**	**0.74**	**0.64**	**0.86**
Chile	**0.44**	**0.36**	**0.54**	**0.50**	**0.41**	**0.61**	**0.72**	**0.58**	**0.88**
South America	**0.49**	**0.39**	**0.62**	**0.55**	**0.44**	**0.70**	**0.78**	**0.62**	**0.98**

	Model 1			**Model 2**			**Model 3**		
	HR	**95% CI**				**95% CI**	**HR**	**95% CI**	
Asia	**1.07**	**1.02**	**1.13**	**1.23**	**1.17**	**1.30**	**1.26**	**1.20**	**1.33**
Turkey	1.05	0.94	1.17	1.20	1.08	1.34	1.21	1.09	1.35
Lebanon	**1.44**	**1.18**	**1.75**	**1.61**	**1.33**	**1.96**	**1.34**	**1.10**	**1.62**
Iran	0.80	0.70	0.91	0.89	0.78	1.01	1.01	0.88	1.15
Iraq	**1.84**	**1.62**	**2.09**	**2.34**	**2.06**	**2.66**	**2.02**	**1.78**	**2.29**
Other Asia countries	0.97	0.88	1.07	**1.12**	**1.02**	**1.23**	**1.19**	**1.08**	**1.31**
Russia	**1.37**	**1.21**	**1.55**	**1.41**	**1.24**	**1.59**	**1.31**	**1.16**	**1.49**

HR, hazard ratio; 95%CI, 95 percent confidence interval Model 1 was adjusted for age and region of residence in Sweden; Model 2 was adjusted for age, region of residence in Sweden, educational level, marital status and neighborhood SES; Model 3 was constructed as Model 2 with inclusion of co-morbidities.

Table 2b.

Incidence of (hazard ratio (HR) with 95% confidence intervals (95% CI)) AF in first-generation female immigrants compared to Swedish-born individuals (N=1,727,650)

	Model 1			Model 2			Model 3		
	HR	**95% CI**		**HR**	**95% CI**		**HR**	**95% CI**	
Sweden	1			1			1		
Nordic countries	**1.05**	**1.03**	**1.08**	**1.07**	**1.05**	**1.10**	1.01	0.99	1.04
Denmark	**0.92**	**0.87**	**0.98**	**0.91**	**0.86**	**0.97**	**0.93**	**0.87**	**0.99**
Finland	**1.10**	**1.07**	**1.13**	**1.14**	**1.11**	**1.17**	**1.07**	**1.04**	**1.10**
Iceland	**0.36**	**0.21**	**0.61**	**0.40**	**0.24**	**0.67**	**0.57**	**0.34**	**0.97**
Norway	1.01	0.96	1.07	1.00	0.95	1.06	**0.92**	**0.87**	**0.97**
Southern Europe	**0.51**	**0.45**	**0.57**	**0.55**	**0.48**	**0.62**	**0.72**	**0.63**	**0.81**
France	**0.54**	**0.39**	**0.75**	**0.64**	**0.46**	**0.89**	0.73	0.52	1.01
Greece	**0.46**	**0.37**	**0.57**	**0.47**	**0.38**	**0.58**	**0.70**	**0.56**	**0.87**
Italy	**0.47**	**0.38**	**0.59**	**0.52**	**0.42**	**0.65**	**0.67**	**0.53**	**0.83**
Spain	**0.66**	**0.48**	**0.91**	**0.72**	**0.53**	**0.99**	0.85	0.62	1.16
Other Southern Europe	0.63	0.40	1.00	**0.60**	**0.38**	**0.95**	0.80	0.50	1.27
Western Europe	**0.88**	**0.84**	**0.93**	0.97	0.92	1.02	**0.93**	**0.89**	**0.98**
The Netherlands	**0.68**	**0.51**	**0.89**	0.78	0.59	1.02	0.85	0.65	1.12
UK and Ireland	**0.61**	**0.50**	**0.74**	**0.70**	**0.57**	**0.85**	0.88	0.72	1.08
Germany	**0.93**	**0.88**	**0.99**	1.01	0.96	1.07	0.95	0.89	1.00
Austria	0.96	0.82	1.13	1.04	0.89	1.23	0.89	0.76	1.04
Other Western Europe	**0.70**	**0.51**	**0.95**	0.85	0.62	1.15	0.96	0.71	1.31
Eastern Europe	**1.17**	**1.08**	**1.26**	**1.12**	**1.04**	**1.21**	**1.15**	**1.07**	**1.25**
Bosnia	**2.07**	**1.67**	**2.56**	**2.54**	**2.05**	**3.15**	**1.99**	**1.61**	**2.46**
Yugoslavia	**1.16**	**1.06**	**1.27**	**1.07**	**0.97**	**1.17**	**1.13**	**1.03**	**1.24**
Croatia	0.81	0.54	1.20	0.73	0.49	1.08	0.94	0.63	1.41
Romania	0.92	0.71	1.19	1.00	0.78	1.30	0.90	0.69	1.16
Bulgaria	0.70	0.39	1.26	0.87	0.48	1.56	0.84	0.47	1.52
Other Eastern Europe	1.31	0.73	2.36	1.07	0.60	1.94	1.02	0.57	1.85
Baltic countries	0.95	0.87	1.03	1.07	0.98	1.16	0.96	0.88	1.04
Estonia	0.96	0.88	1.05	1.07	0.98	1.17	0.96	0.88	1.05
Latvia	0.89	0.72	1.11	1.07	0.87	1.32	0.94	0.76	1.17
Central Europe	**1.14**	**1.07**	**1.22**	**1.22**	**1.15**	**1.31**	**1.12**	**1.04**	**1.19**
Poland	**1.23**	**1.12**	**1.35**	**1.30**	**1.18**	**1.42**	**1.14**	**1.04**	**1.25**
Other Central Europe	0.91	0.78	1.07	1.01	0.86	1.18	1.02	0.87	1.20
Hungary	**1.17**	**1.04**	**1.32**	**1.26**	**1.12**	**1.42**	**1.14**	**1.01**	**1.29**
Africa	0.65	0.45	0.93	0.74	0.52	1.07	0.89	0.62	1.29
North America	0.86	0.77	0.97	0.93	0.83	1.04	0.92	0.82	1.03
Latin America	**0.60**	**0.49**	**0.74**	**0.65**	**0.53**	**0.80**	0.83	0.68	1.02
Chile	**0.59**	**0.45**	**0.78**	**0.63**	**0.48**	**0.83**	0.79	0.60	1.05
South America	**0.62**	**0.46**	**0.83**	**0.68**	**0.51**	**0.91**	0.89	0.66	1.19

	Model 1			Model 2			Model 3		
	HR	95% CI		HR	95% CI		HR	95% CI	
Asia	**1.35**	**1.25**	**1.47**	**1.39**	**1.28**	**1.50**	**1.37**	**1.26**	**1.49**
Turkey	**1.79**	**1.58**	**2.03**	**1.74**	**1.53**	**1.97**	**1.63**	**1.44**	**1.85**
Lebanon	**1.82**	**1.32**	**2.51**	**1.77**	**1.28**	**2.44**	**1.67**	**1.21**	**2.31**
Iran	0.71	0.53	0.95	0.74	0.56	0.99	0.76	0.57	1.02
Iraq	**2.34**	**1.84**	**2.97**	**2.66**	**2.10**	**3.39**	**2.08**	**1.63**	**2.64**
Other Asia countries	1.03	0.89	1.20	1.09	0.94	1.26	**1.18**	**1.02**	**1.36**
Russia	1.10	0.97	1.26	**1.18**	**1.03**	**1.34**	1.00	0.88	1.15

Model 1 was adjusted for age and region of residence in Sweden; Model 2 was adjusted for age, region of residence in Sweden, educational level, marital status and neighborhood SES; Model 3 was constructed as Model 2 with inclusion of co-morbidities.