Investigating salmon bias among international immigrants in Sweden. A register-based cohort study

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Background

Migrants are generally observed to have lower mortality rates than host populations in high-income countries. Prior research has suggested that this mortality advantage might be explained by the fact that immigrants in poorer health might be more prone to return to their home countries (Pablos-Méndez. 1994. Turra and Elo. 2008; Aldridge et al. 2018), leading to a positive health selection among those who remain. This phenomenon, commonly known in the literature as *salmon bias* (Pablos-Méndez 1994) has been suggested as a key explanation for the unexpected mortality advantage observed among migrants relative to natives in most receiving countries (Aldridge et al. 2018).

Studies looking at the salmon bias hypothesis have focused principally on internal migrations (e.g., Puschmann et al. 2017 and Andersson and Drefahl, et al. 2018) to isolate this effect from under-reported out-migration. This has been presented as one of the major limitations in migrant health research, also leading to possible underestimation as a result of numerator-denominator mismatch whereby individuals who have actually emigrated continue to be included in administrative registers. Yet attempts to evaluate under-reported out-migration have systematically failed to show that such a denominator bias exists (e.g., Abraído-Lanza et al. 1999; Weitoft et al. 1999; Turra and Elo, 2008).

A Danish study recently showed a lower risk of out-migration among refugee and family reunification migrants with high disease severity relative to those without disease (Norredam et al. 2015). However, the generalization of these findings to other migrant groups is unclear. Migrants coming from countries in conflict might not be able to return (and treatment might not be guaranteed). Furthermore, Denmark is considered to have an ‘exclusionist’ approach to migration (CIDOB, Malmusi, 2015) that can also influence the decision to emigrate among those in good health seeking for better opportunities in other countries. Finally, the above-mentioned study does not account for un-registered out-migrations.

Using several linked Swedish population registers, we aim to identify migrants who have left the country and to assess whether there is evidence of health selection compared to those who remain. Although a priori health differences between migrants with recorded and unrecorded out-migration are not expected, our data allows us to create proxy measures of unrecorded out-migration to enable comparisons of migrants in both groups. Effect modification by region of origin and duration of residence will also be considered, as we expect that more recent migrants and labour migrants are more likely to emigrate, than more established immigrants and forced migrants coming from countries in conflict.

Data and methods

Study population

We used data from several anonymously linked national Swedish administrative registers. The study population consists of all foreign-born persons living in Sweden who immigrated between 1970 and 2001 and were of working age (defined as 18-65 years old) during the follow-up period (1990-2002).

Outcome and covariates

The outcome was defined as the first out-migration from Sweden in the follow-up period 1990-2006. Out-migration was defined as a recorded date of migration by the authorities, or a proxy, measured when sources of income (e.g., job-earnings or social benefits) were not registered for two consecutive years for the same individual. We also conducted sensitivity analyses that considered reported out-migration only.

The main exposure variable was the Charlson index of co-morbidity (Charlson et al. 1987), an annual numeric measure that is calculated using annual information on reason for hospitalizations (based on ICD codes) during the two years before the start of the follow-up (main analysis) or at the start of the two recessionary time-periods (1988-1989 and 1994-1995) in stratified analyses. The Charlson index was used in the model in a linear form.

Additional covariates, including sex (men and women), age (18 to 24; 25 to 35; 35 to 45; 45 to 55 and more than 55 years), duration of residence (5 to 10; 10 to 15; 15 to

20; and more than 20 years) and region of birth (Finland, Rest of Scandinavia, Rest of Europe, Former Yugoslavia, the Middle East, and Rest of the World) were considered.

Statistical analyses

A retrospective cohort study was conducted with parametric duration models (Cox regression) using year as the time-scale to derive Hazard Ratios (HR) and 95% Confidence Intervals (CI). Analyses were run on the entire follow-up period and stratified by the two recessionary time-periods (as indicated above). Using the Wald test, we formally assessed for interactions between the exposure (Charlson's index) and recessionary time-periods, as well as region of birth and duration of residence. All models were adjusted for age and sex and used robust standard errors.

This study was approved by the Regional Ethical Review Board of Stockholm (decision no. 2012/1260-31).

Preliminary results

Emigration rates were slightly higher among men than women. Emigration rates varied by region of origin, with the lowest rates observed among those from former Yugoslavia and the Middle East, who are likely to have migrated as refugees. The highest rates of emigration were seen in Scandinavian migrants (excluding Finland).

During the follow-up period, emigration was significantly lower among immigrants who suffered from ill-health (HR: 0.79; 95%CI:0.74-0.83) relative to those who did not. Emigration was higher for immigrants coming from other Scandinavian countries (HR:1.70:95%CI:1.67-1.73) relative to those from Finland; all other origin groups showed lower risk of emigration relative to those from Finland. Furthermore, emigration was less likely to occur with increasing duration of residence (HR_{5-9}: 0.51;95% CI:0.50-0.52; HR_{10-14}:0.32;95%CI:0.32-0.33; HR_{15-19}:0.20;95%CI:0.20-0.21; $HR_{\geq 20}$:0.19;95%CI:0.15-0.16).

There was no interaction between the Charlson index and duration of residence (p=0.26). An interaction was found between the Charlson indicator and region of origin (p=0.01). Additional analysis revealed that this was driven by migrants from the rest of Scandinavia, and that the health of migrants from this region may be better than suggested by estimates without the interaction term (Charlson score of 1.25 vs 1.02).

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