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Original Research Article

The impact of forced migration on mortality: a cohort study of 242,075 Finns from 1939–2010

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Abstract

Background The stresses and life changes associated with migration may have harmful long-term health effects, especially for mental health. These effects are exceedingly difficult to establish, because migrants are typically a highly selected group.

Methods We examined the impact of migration on health using 'naturally occurring' historical events. In this paper, we use the forced migration of 11% of the Finnish population after WWII as such a natural experiment. We observed the date and cause of death starting from January 1st 1971 and ending in December 31st 2010 for the cohort of 242,075 people. Data were obtained by linking individual-level data from the 1950 and 1970 population censuses and the register of death certificates from 1971 to 2010 (10% random sample). All-cause and cause-specific mortalities were modeled using Poisson regression.

Results Models with full adjustment for background variables showed that both all-cause mortality (RR 1.03, 95% CI 1.01-1.05), and ischemic heart disease mortality (RR 1.11, 95% CI 1.08-1.15) were higher in the displaced population than in the non-displaced population. Suicide mortality was lower (RR 0.77, 95% CI 0.64-0.92) in displaced than in the general population.

Conclusions In our long term follow-up study, forced migration was associated with increased risk of death due to ischemic heart diseases. In contrast, lower suicide mortality was observed in association with forced migration 25 years or more.

Introduction

The stresses and life changes associated with migration may have harmful long-term health effects [1,2], especially for mental health [3–5]. These effects are exceedingly difficult to establish, because migrants are typically a highly selected group e.g. in terms of better education, better underlying health status and higher motivation to improve the economic well-being of themselves and their relatives [6,7]. However, experimental allocation to exposed and non-exposed groups (migrant vs non-migrant) is both impossible and unethical. Thus, the best feasible approach for examining the impact of migration on health is to use 'naturally occurring' historical events that resemble experimental study designs [8]. In this paper, we use the forced migration of 11% of the Finnish population after WWII as such a natural experiment.

After WWII, Finland ceded its eastern parts to the Soviet Union and resettled everyone living in the lost areas into the remaining parts of the country. The displaced and non-displaced populations were comparable to each other in terms of their pre-war economic conditions and education [9]. Furthermore, the evacuation was conducted efficiently and safely. Thus this historical episode provides us with an exceptional research design for examining the impacts of forced migration.

The Finnish government created a resettlement policy that aimed to mitigate the impacts of the displacement [10,11]. Farmers were given land and assistance to establish new farms in locations resembling their old farms in terms of soil quality and average temperature. Rural communities were resettled together in order to preserve social connections. Urban population was free to resettle wherever they could find accommodation and received monetary compensation for their lost property.

Earlier work examining the resettlement experience suggests that forced migration increased the urbanization and income of those migrating from rural areas, while having the opposite effect on urban migrants [9]. Previous results on health are mixed. One study reports a 20% higher mortality risk for displaced men during years 1989-1992 in comparison to non-displaced men, but no differences for other time periods or for women[12]. Another study compares displaced and non-displaced populations living close to the post-war Finnish-Soviet Union border and reports a lower myocardial infarction incidence among the displaced population in 1972 [13]. In comparison to the previous work, on health outcomes our study uses larger and richer data that allow for conditioning on pre-war

socioeconomic characteristics and a longer follow-up period. These data allow us to substantially revise the conclusions suggested by earlier work on the effects of forced migration on mortality.

The aim of this study is to shed light to the long-term effect of forced migration on mortality of the displaced population compared to general population in Finland. In addition to all-cause mortality, we focused on cardiovascular- and alcohol-related deaths, suicide, and other external causes of death, because it is reasonable to assume that these are most affected by stress connected to forced migration [14].

Methods

Statistics Finland created our data by merging together individual-level data from the 1950 and 1970 population censuses and the register of death certificates from 1971 to 2010. The initial study population consisted of a 10% random sample of Finnish households numerated in the 1950 census (N=411,629). Only people who were born before 1945 were included, because the last evacuations took place in 1944 (N=281,989).

In our analysis, we controlled for the following background variables taken from the 1950 census data: year of birth (1870-1944), age, sex, language (Finnish, Swedish, or other), area of residence in 1950 (nine provinces) and socioeconomic status in 1939 (entrepreneurs, white collar worker, blue-collar worker, family member of a white-collar worker, family member of a blue-collar worker, not in work force). In additional analysis, we also controlled for socioeconomic status in 1950 (employer, entrepreneur, white-collar worker, blue-collar worker, not in work force) and in 1970 (employer, entrepreneur, upper white-collar, lower white-collar, blue-collar, unskilled blue-collar, retired, other).

We measured displacement status using information about the municipality of residence in September 1st, 1939 – two months before the Soviet Union attacked Finland. We define displaced people as those who in 1939 lived in a municipality that was fully ceded to the Soviet Union. As virtually all residents in the ceded areas migrated, this definition does not lead to any significant biases. Those living in partly ceded municipalities were excluded from our sample.

No data were available between censuses 1950 and 1970. About 14.2% (N= 39,914) of population was lost from follow-up between these censuses due to death or emigration from Finland [15]. The analyses of the nature of this loss to follow-up are given in Appendix 1; but as a summary this leads to a minor over-representation of females, Finnish speakers, and non-displaced people in the follow-

up population. The study was approved by the ethical review board of The National Institute for Health and Welfare, Finland.

We observed the date and cause of death starting from January 1st 1971 and ending in December 31st 2010 for the cohort of 242,075 people. We studied all-cause mortality, ischemic heart disease (IHD) (ICD-10 I20-I25), cerebrovascular diseases (CD) (I60-I69), alcohol related disease and accidental poisoning by alcohol (F10, G312, G4051,G621, G721, I426,K292, K70, K860,K8600, 0354, P043,X45), all accidental causes (V01-X44, X46-X59,Y85-Y86), and suicide (X60-X84, Y870). Comparable codes were used when ICD-9 and ICD-8 were in use.

We modeled all-cause and cause specific mortality between 1971 and 2010 using Poisson regression models with the number of deaths as outcome and displacement status, age, sex, native language, socioeconomic status in 1939, and birth cohort. Logarithm of person-years was used as the offset term. Results of Poisson models are presented as rate ratios (RR) with 95% confidence intervals. We tested interaction using likelihood ratio tests. We also analysed intensity (hazard) of death using Poisson regression model separately for the displaced and non-displaced populations. We arranged data in Lexis structure and utilized the R language and its Epi-package for data analyses [16,17].

Results

In total 6.48 million person-years and 159,100 deaths accumulated during follow-up. The mean follow-up time was 26.8 years. Results from Poisson regression models with full adjustment for background variables showed that both all-cause mortality (RR 1.03, 95% confidence interval (CI) 1.01-1.05), and IHD mortality (RR 1.11, 95% CI 1.08-1.15) were higher in the displaced population than in the non-displaced population (Table). On the other hand, suicide mortality was lower (RR 0.77, 95% CI 0.64-0.92) than in the general population. We tested interaction between displacement status and age, sex, birth cohort, province, and socioeconomic status in 1939, but did not detect any interactions at the $p<0.05$ level. We did not find mortality differences between displaced and non-displaced population for other causes than ischemic heart disease and suicides. Detailed results are reported in Appendices 3-8.

To control more accurately for geographic location of the displaced persons, we carried out subgroup analyses including only provinces on the eastern border (Kymi (5), Mikkeli (6), Kuopio (7)) (Figure 1). In these analyses displaced populations living in provinces near eastern border were compared to non-displaced people in the same province. The differences in the excess mortality of the displaced persons between whole country and border province model were minor (Appendix 2).

The only difference was in all-cause mortality, where RR in the border province model was 0.99 (95% CI 0.96-1.02) compared with the whole country model RR 1.02 (95% CI 1.01-1.04). The point estimate for IHD mortality was 1.06 (95% CI 1.00-1.12) and suicide was 0.59 (95% CI 0.40-0.87) in this more restricted comparison.

The mortality hazard for myocardial infarction increased during the follow-up with similar patterns observed both in the displaced and the general population (Figure 2), the only difference being the lower level observed in the general population. However, in suicides, the pattern of change in the mortality hazard is more variable, although due to the lower number of cases it is not easy to detect whether this variability is simply due to sampling variability.

Discussion

Summary of the main findings

The results of this study suggest that even 25 years after forced migration there are differences in mortality between the displaced and the general population. We observed about a 10% higher mortality due to IHD in the displaced population. Because these deaths contribute about 30% of deaths from all causes, also all-cause mortality was slightly increased (2%, 95% CI 1%-4%) in the displaced population. On the other hand, mortality from suicides was at a lower level in the displaced population. There is quite a large east-west difference in mortality with lower IHD mortality in Western Finland. This may be partly due to genetic differences that reflect the two-phase settlement history of Finland [18,19]. However, in our full model this was controlled for and it is unlikely that the higher mortality rate in the displaced population is due to east-west difference. When we restricted the analysis to provinces on the eastern border, the effect of displacement on IHD mortality diminished while the suicide risk in the displaced population was even lower than in the full data. We found no interaction between re-settlement province and displacement status. This indicates that the province where the displaced persons were resettled did not modify the association between mortality and displacement status.

Reasons for increased IHD mortality among the displaced persons

The increased IHD mortality in the displaced population could be plausibly explained by the long-term effect of stress and displacement caused by the evacuation process itself, and resettling to the new areas. The excess risk of IHD associated with having been displaced is in the lower range of associations observed in other studies examining the role of other social predictors of cardiovascular disease. For example, recent meta-analyses reported 1.5-fold increased risk associated with social isolation and 1.3-fold risk for workplace stress[14]. The age at exposure to displacement varied: some

members of the study group were children, others were adults, but we found no interaction between birth cohort and displacement status, suggesting that the effect of displacement on IHD mortality was not modified by the age at which displacement was experienced. The finding is consistent with a recent study that compared the effects of childhood adversity and adult disadvantage on cardiovascular risk[20]. Individually both were associated with similar, about 1.4-fold excess risk, but when the combined exposure to both childhood adversity and adult disadvantage was compared with either exposures alone or no exposure, individuals with both exposures had over 2-fold risk whereas those with either exposure alone had little excess risk[20]. Unfortunately, we could not investigate the role of cumulative adversity in the current study. It also remains possible that some of the excess IHD mortality among the displaced population may be due to behavioral factors they brought with them, such as long-established dietary preferences common in the ceded areas.

Our main results are also confirmed – although attenuated – in an analysis comparing the ceded areas to the three closest eastern provinces of Finland. Furthermore, published cause-of-death statistics before WWII indicate that differences in mortality due to diseases of the circulatory system ("morbi organorum circulationis") between the ceded Wyborg (Viipuri) province and the rest of Finland were small[21]. In 1938 mortality to diseases of the circulatory system in the Wyborg province was 252 per 100,000, and in the whole of Finland 249. This means that the ceded region did not differ from other parts of Finland before WWII in respect with mortality due to diseases of the circulatory system and it is thus unlikely that pre-war disease patterns are driving our results.

Our results differ from an earlier study suggesting that all-cause and IHD mortality among Finnish displaced and non-displaced populations was similar except for the years 1989-1992 [12]. An important limitation of this earlier study is that the conclusions hinge on a single statistically significant estimate and multiple testing issues are not discussed. Furthermore, the authors do not provide evidence of their suggested causal mechanism: a noteworthy change in the public debate about the ceded areas and its psychological consequences. In contrast, we find consistently higher IHD mortality among the displaced population over the 1971-2010 period and no spikes around the turn of the 1990s (Figure 2). The most likely reason for the differences between our results and this earlier study is that we use a larger dataset that includes a more precise measure of displacement status and information on pre-war characteristics. Consequently, we obtain more precise estimates. Our findings suggest that the conclusions of this earlier study are likely to be incorrect.

Although not directly comparable due to a much shorter follow-up time and no appropriate control population, it is interesting to observe that the results from a mortality study among refugees to Sweden in the period 1998 to 2006 are quite different [22]. In this Swedish study, refugee men had

higher mortality from cardiovascular (HR 1.53, 95% CI 1.04-2.14) and external (HR 1.59, 95% CI 1.10-2.50) causes when compared with male non-laborer, non-refugee immigrants, and no difference in all-cause mortality. In women no differences were observed. It is evident that cardiovascular mortality in men had similar pattern in these quite different populations of forced migrants.

Why forced migration can be protective for suicide?

Mortality from suicide was lower in the displaced population compared to the general population. This finding was unexpected: negative life events in both childhood and adulthood are known risk factors for mental disorders and suicide [23]. However, suicide is an act of intentionally ending life, having multifactorial causes and no one-to-one relationship to mental disorders or other risk factors [24]. The motivational-volitional model of suicide stresses current feelings of defeat and entrapment as the most important triggers of suicidal behavior [24]. On the other hand, efficient problem solving and coping mechanisms provide resilience [24]. Our finding suggests that a major negative life event like forced migration is not a risk factor for suicide after 25 years or more after its occurrence. On the contrary, surviving from it might even provide resilience against suicidality. Interestingly, an earlier study found that after 25 years after the evacuation, income of displaced men had increased more rapidly than in the general population [9]. This increased long-term income in men could reflect effective coping strategies and higher social connectivity in the displaced population. Our finding of lower mortality from alcohol-related causes in the displaced population suggests that these people had personal or social resources that could protect from suicidal behaviour. Classification of causes of death in Finland is considered to be of very high quality due to the high autopsy rate [25], and therefore misclassification bias with respect to suicide is unlikely to explain this specific finding.

However, there are also alternative explanations for the lower suicide mortality among the displaced persons. It is possible that the segment of the displaced population with elevated suicide risk was lost from follow-up between years 1950 and 1970; although we believe such bias to be small (see eAppendix 1 and section on 'Methodological considerations'). Unfortunately, previous studies of suicide risk in the displaced population from years 1945 to 1970 do not exist, and it is not known whether initially their suicide risk was elevated. However, Official Statistics of Finland separately reported on the evacuated population of the ceded provinces for few years after the war. These statistics suggest that the proportion of suicides of all deaths was not higher in the years immediately after the war [26]. Furthermore, suicide risk in the entire Finnish population was lower in the first decade after World War II than it was in the years preceding the war [27]. Another explanation for lower suicide mortality in the displaced population might be that suicide rates in ceded parts of the country were lower already before WWII. In order to investigate this hypothesis we checked

suicide mortality before WWII (1938) in different provinces of Finland [21]. It turned out that the suicide mortality in ceded Wyborg (Viipuri) province was 29.7 per 100,000 for males and 7.9 for females, which were quite similar to the whole country rates of 30.0 and 7.1, respectively. This means that it is unlikely that the observed lower suicide mortality after displacement was due to regional differences in suicide before WWII.

Methodologic considerations

We used high quality register based data on a 10% sample of households drawn from the 1950 Finnish Census of Population with a follow-up in subsequent censuses and death records. The strengths of these data are that neither early nor adult characteristics are self-reported and thus are not subject to recall bias or misreporting and we have no loss to follow-up after the beginning of our mortality follow-up beginning 1 January 1971. Forced migration of a large population also provides us with an exceptional research design for examining the impacts of forced migration.

As a limitation of our study, it should be noticed that about 14% of population in census 1950 was not included in the study population at the start of follow-up in 1970, and we have no direct information on the reasons of attrition. This means that the results and conclusions about cause-specific mortality are valid only for the population that was alive and residing in Finland at the beginning of follow-up in 1 January 1971. We believe, however, that this sample selection bias is likely to be relatively small; in Appendix 1 we showed that differences in attrition on the basis of pre-war sociodemographic characteristics are small (between 1-2 %). Furthermore, in order for pre-1970 suicides to fully explain our results, suicide mortality in 1950-70 would have to be 88% higher in the displaced population than in the general population (Appendix 8). Taking into account that suicide mortality in the ceded areas was similar to the suicide mortality of the general population before WWII and that suicide mortality was low immediately after the war, this bias seems very unlikely.

Conclusions

Overall, our finding of about 10% higher IHD mortality in the displaced population is in line with previous review studies showing excess of cardiovascular disease risk [14], and is plausibly associated with the long-term stress caused by life events connected to displacement. On the other hand, lower suicide mortality in displaced population may reflect the different nature of these two causes of death. Suicide is a behavior, the act of an individual intentionally ending their own life [24], that typically involves proximal risk factors precipitating the act. In contrast, higher risk of IHD death may

reflect the biologic effects of long-term stress or changes in behavior and living conditions associated with displacement.

In conclusion, our study presents evidence on long-term effects of forced migration on mortality even when the evacuation was well organized and the resettlement policy was remarkably generous. Most population displacements related to armed conflicts take place in arguably harsher conditions and may thus have larger impact on mortality. On the other hand, important forced migrations take place also due to natural disasters and infrastructure projects. For example, dam construction alone is estimated to have displaced 40–80 million people since WWII [29]. Our results suggest that these events may have long-term health consequences even when governments provide appropriate monetary compensation to the displaced persons.

Contributors

JH, JS, MS, and PM designed the study. JH, MS and PM collected data, and JH analysed data. JH prepared results and wrote the first draft of the report with input from other authors. All authors commented on draft report and approved the final version.

Declaration of interests

All authors declare no competing interests.

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Figure 1 Finland with current borders and parts of Karelia and other regions relinquished to Soviet Union after World War II (hatched) [28]. Provinces of Finland in the year 1945: Uusimaa (1), Turku and Pori (2), Åland (3), Häme(4), Kymi (5), Mikkeli (6), Kuopio (7), Vaasa (8), Oulu (9), and Lappi (10).

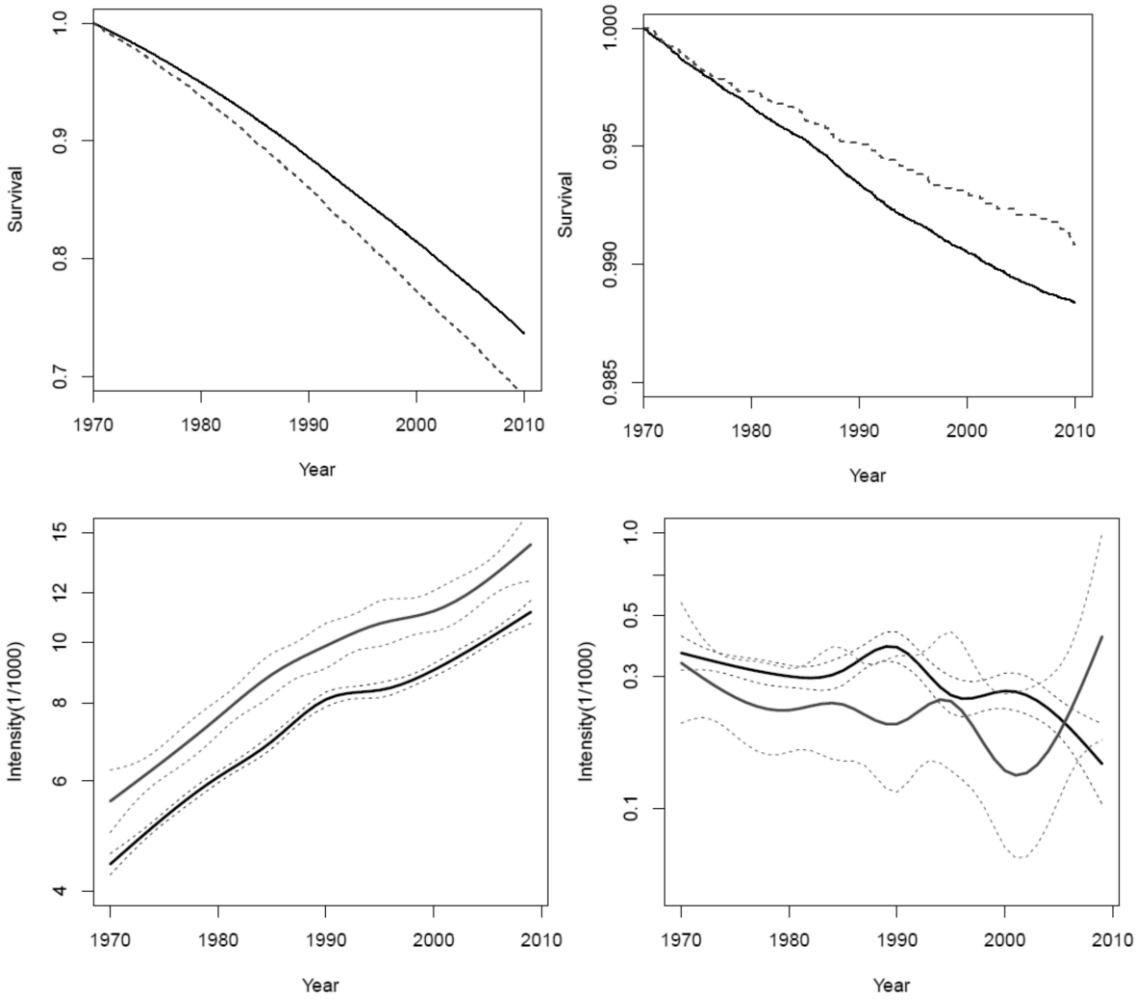

Figure 2 Survival curves for death caused by myocardial infarction (left, top) and suicide (right, top) for general population (black continuous line) and displaced population (dashes). In bottom intensity (hazard) of death by myocardial infarction (left) and suicide (right) with 95% confidence intervals. Note log y-axis with varying scales for myocardial infarction and suicide.

Table 1 Mortality rates and model based relative mortality ratios (RR) for all cause and cause specific mortalities. Adjusted RR based on Poisson regression models. Full model include evacuation status, age, sex, language, socioeconomic status 1939, and area of residence as covariates.

				Univariate			Age and sex adjusted			Full model		
	Evacuated	**N cases**	**Rate (1/1000)**	**RR**		**95% CI**	**RR**		**95% CI**	**RR**		**95% CI**
All-cause mortality	no	144618	24.28	(reference)			(reference)			(reference)		
	yes	14482	27.77	1.14	1.12	1.16	1.05	1.03	1.06	1.03	1.01	1.05
Ischemic heart disease	no	42323	7.11	(reference)			(reference)			(reference)		
	yes	4584	8.79	1.24	1.20	1.28	1.13	1.09	1.16	1.11	1.08	1.15
Cerebrovascular disease	no	16861	2.83	(reference)			(reference)			(reference)		
	yes	1739	3.33	1.18	1.12	1.24	1.07	1.01	1.12	1.03	0.98	1.08
Alcohol-related disease	no	1837	0.31	(reference)			(reference)			(reference)		
	yes	158	0.30	0.98	0.84	1.16	0.98	0.83	1.15	0.94	0.80	1.10
Accident	no	5160	0.87	(reference)			(reference)			(reference)		
	yes	447	0.86	0.99	0.90	1.09	0.98	0.83	1.15	0.92	0.84	1.02
Suicide	no	1815	0.30	(reference)			(reference)			(reference)		
	yes	123	0.24	0.77	0.64	0.93	0.79	0.66	0.95	0.77	0.64	0.92