

## RESEARCH REPORT

# Migration and mortality: a 20 year follow up of Finnish twin pairs with migrant co-twins in Sweden

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**Study objective:** Finland has a higher mortality overall and for major causes of death than Sweden, primarily in men. The objective of this study was to analyse mortality in migrants from Finland to Sweden.

**Design:** A longitudinal study based on the Finnish Twin Cohort Study. Information about migration from Finland to Sweden, duration of stay in Sweden for the migrants, and deaths 1976–1995 was obtained from national registers. Observed numbers of deaths in migrants were compared with expected numbers based on the age standardised mortality experience of the Finnish Twin Cohort. First deaths in migrants and non-migrants of migrant discordant pairs were compared controlling for genetic and early childhood factors.

**Participants:** Twin pairs of the Finnish Twin Cohort Study where at least one twin had migrated to Sweden (1542 twin pairs).

**Main results:** Among men, migrants from Finland to Sweden showed an overall similar mortality compared with all subjects of the Finnish Twin Cohort (SMR 1.1; 95% CI 0.9 to 1.4). Mortality from non-violent causes was increased for migrants with at most 20 years in Sweden (SMR 1.9; 95% CI 1.2 to 2.6) and decreased in those with a longer stay (SMR 0.7; 95% CI 0.4 to 0.9). Similar results were obtained concerning first deaths in twin pairs discordant for migration. Among women, migrants had an increased mortality overall (SMR 1.4; 95% CI 1.0 to 1.8), from cardiovascular disease (SMR 1.7; 95% CI 1.0 to 2.7), and from violent causes (SMR 2.5; 95% CI 1.2 to 4.6) compared with all women of the Finnish Twin Cohort. In analyses of migrant discordant pairs only first deaths from cardiovascular disease tended to be more common in the migrants than in non-migrant co-twins.

**Conclusions:** Migrants from Finland to Sweden seem to have an overall mortality comparable to that prevailing in Finland suggesting no strong influence on mortality by the migration. Duration of stay seems to be associated with mortality in the migrants, at least in men, with a lower mortality after several years in Sweden.

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International migration may imply changes in environment and behaviour that influence the risk of disease for the migrants.<sup>1–7</sup> After the second world war large migration from Finland, basically labour migration, has resulted in a migrant population in Sweden of about 240 000 Finnish born persons. Men in Finland have a considerably higher mortality overall and with regard to major causes of death than men in Sweden.<sup>8</sup> Among women the mortality is higher in Finland than in Sweden but the differences are less pronounced. Finnish migrants in Sweden seem to have a poorer health than native Swedes with regard to cardiovascular, psychiatric as well as musculoskeletal diseases.<sup>9–11</sup> An observed reduced incidence of myocardial infarction among migrants after several years in Sweden may indicate a favourable influence of long term changes in behavioural and environmental factors.<sup>12</sup>

Migrant studies take advantage of a "natural experiment" and may contribute to the understanding of how changes in environmental and behavioural factors influence the risk of disease. An observed lower mortality among migrants than in the population of the host country or of the population of the country from which they migrated<sup>13–15</sup> may, however, in part be attributable to factors relating to decision to migrate or conditions for migration. The Finnish Twin Cohort Study<sup>16</sup> includes many subjects that have moved from Finland to Sweden. Analysis of twin pairs where one twin has migrated to Sweden and the co-twin has stayed in Finland ("migrant discordant" pairs) has methodological advantages including that the migrant twin and the non-migrant co-twin share genetic factors and childhood environment. The aim of this study was to compare the mortality among migrants from Finland to Swe-

den with that of non-migrants in Finland, using information from the Finnish Twin Cohort Study.

## METHODS

The Finnish Twin Cohort Study was established in 1974 and consists of all same sexed twin pairs born in Finland before 1958 with both twins alive in 1975 (n=13 888 twin pairs).<sup>16</sup> All twins of the Finnish Twin Cohort Study who had migrated to Sweden before the end of 1993 were identified through the Central Population Register of Finland. Migrants were defined as persons at least once registered as residents in Sweden and non-migrants as persons not registered and remaining in Finland.

Swedish personal identification numbers were obtained through tax authorities by using information about date of birth and name. A date of migration, as well as of eventual re-migration to Finland, during 1968–1994 was obtained from Statistics Sweden. Information about residency in Sweden was obtained from the 1960 census, and from Swedish population registers by 31 December 1968 and 1978, and October 1995 respectively. In the analyses, migrants residing in Sweden since at least 1960 were assigned a duration of stay in Sweden of at least 20 years at the start of the study period (1976). Migrants, who were living in Sweden in 1968 but not in 1960, were assigned a duration in Sweden corresponding to migration in 1965.

A questionnaire was mailed to all twins of the Finnish Twin Cohort Study in 1975 including questions on health, lifestyle factors, occupation, working conditions, and socioeconomic

**Table 1** Number of twin pairs of the Finnish Twin Cohort study where at least one twin had migrated to Sweden. By sex and age at baseline in 1975

Age 1975	One twin migrated			Both twins migrated			Total
	Men	Women	All	Men	Women	All	
<30 y	256	278	534	155	159	314	848
30–39 y	196	142	388	56	33	89	427
40–49 y	72	60	132	21	18	39	171
≥50 y	36	50	86	4	6	10	96
Total	560	530	1090	236	216	452	1542

factors.<sup>16 17</sup> The response rate was 89%, but only 47% for migrants to Sweden and 56% for migrants of migrant discordant pairs. Migrant discordant pairs where both members of the pair had responded to the 1975 questionnaire (n=570) were analysed with regard to several factors, many of which were measured by standard scales or instruments that have been described earlier.<sup>17 18</sup>

Information about deaths was collected for the period 1 January 1976 to 31 December 1995 through National Cause of Death Registers in the two countries. The analyses of mortality concerned death from all causes, cancer (International Classification of Diseases (ICD) 8 and ICD 9 code 140–239), cardiovascular diseases (ICD 8 code 390–458 and ICD 9 code 390–459), coronary heart disease (ICD 8 and ICD 9 code 410–414), violent causes—that is, accidents, suicides and homicides (ICD 8 and ICD 9 code E800–E999) and all non-violent causes (all causes except violent causes).

#### Statistical analysis

Migrants and non-migrants of migrant discordant pairs were compared regarding items of the 1975 questionnaire by percentage differences with 95% confidence intervals. The observed number of deaths among the migrants was compared with an expected number based on the sex and age (five year age groups) specific mortality of all members of the Finnish Twin Cohort Study during 1976–1995 by standardised mortality ratios (SMR), with 95% confidence intervals. The observed number of cases was assumed to follow a Poisson distribution. Person years were calculated beginning at the start of the follow up 1 January 1976 or at the time of first migration to Sweden whichever came later, and ended 31

December 1995, at the time of first migration back to Finland or at the time of death, whichever came first. Analyses were also performed where migrants returning to Finland were followed up after re-migration.

For migrant discordant pairs first deaths within the pair were determined. In these analyses the follow up was ended for both members of the pair 31 December 1995, at the time of first migration back to Finland or when the first one died, whichever came first. The proportion of all first deaths that occurred among migrants was calculated together with a 95% confidence interval based on the binomial distribution.

#### RESULTS

In all, 1994 migrants to Sweden were identified in the Finnish Twin Cohort Study belonging to 1542 twin pairs of which 1090 “migrant discordant” pairs (table 1). The time of first migration to Sweden and the length of time spent in Sweden were determined for 1925 subjects (97%).

#### Baseline data from the 1975 questionnaire

For most items of the 1975 questionnaire there were small differences between the migrant and the non-migrant (table 2). The proportion of blue collar workers tended to be higher among migrants and among men this also concerned a comparatively high alcohol consumption. Among women, smoking and physically heavy labour was more common among migrants and work disabling back pain, neck pain or shoulder pain less common.

**Table 2** Characteristics of migrants and non-migrants of migrant discordant pairs of the Finnish Twin Cohort Study. Data from questionnaire at baseline in 1975. Differences in proportions with 95% confidence intervals

Characteristics	Men (n=246 pairs)				Women (n=324 pairs)			
	Migrants %	Non-migrants %	Difference %	95% CI	Migrants %	Non-migrants %	Difference %	95% CI
Not married	46	45	1	–8 to 10	39	38	1	–7 to 8
Highest education elementary school	1	1	0	–2 to 2	2	2	0	–3 to 2
Current unemployment	7	5	2	–2 to 6	4	5	–1	–4 to 2
Blue collar worker	67	60	7	–2 to 16	50	42	8	0 to 16
Physically heavy work*	61	58	3	–6 to 12	53	44	9	1 to 17
Current smoker	51	46	5	–4 to 14	37	30	7	0 to 14
Consumption of >10 g pure alcohol per day	48	38	10	1 to 19	9	10	–1	–6 to 3
Almost no exercise	32	28	4	–4 to 12	34	39	–5	–12 to 3
Use of sedatives or sleep pills	9	5	4	–1 to 8	14	12	2	–3 to 7
Body mass index >25	21	22	–1	–9 to 6	14	13	1	–4 to 7
Work-disabling back-neck- or shoulder pain	48	44	4	–5 to 13	37	45	–8	–16 to 0
Angina pectoris	3	3	0	–4 to 3	2	4	–2	–5 to 1
Physician diagnosed hypertension	9	9	0	–6 to 5	10	12	–2	–6 to 4
Shortness of breath†	26	24	2	–6 to 9	43	43	0	–8 to 7
Bronchitis	4	6	–2	–5 to 3	5	6	–1	–4 to 3

\*Standing, walking, lifting or carrying or heavy manual work; †shortness of breath while walking uphill, up stairs or at fast pace on plain ground.

**Table 3** Standardised mortality ratio (SMR) with 95% confidence intervals, comparing the observed and expected number of deaths 1976–95 for migrant twins of the Finnish Twin Cohort Study. Expected numbers obtained from mortality rates of the Finnish Twin Cohort Study. By sex, years in Sweden of migrant and underlying cause of death

Cause of death	≤20 years in Sweden					>20 years in Sweden					All				
	Observed	Expected	SMR	95% CI		Observed	Expected	SMR	95% CI		Observed	Expected	SMR	95% CI	
<b>Men</b>															
All causes	39	24.02	1.62	1.11 to 2.13	37	44.82	0.83	0.56 to 1.09	76	68.84	1.10	0.86 to 1.35			
All non-violent causes	27	14.47	1.87	1.16 to 2.57	24	35.82	0.67	0.40 to 0.94	51	50.29	1.01	0.74 to 1.29			
Cancer	6	3.85	1.56	0.57 to 3.39	0	10.18	–	0.00 to 0.36	6	14.03	0.43	0.16 to 0.93			
Cardiovascular	14	6.96	2.01	1.10 to 3.37	17	18.98	0.90	0.52 to 1.43	31	25.95	1.19	0.77 to 1.62			
Coronary heart disease	11	4.63	2.38	1.19 to 4.25	8	13.96	0.57	0.25 to 1.13	19	18.59	1.02	0.62 to 1.60			
Violent causes	12	9.55	1.26	0.65 to 2.19	13	9.00	1.44	0.77 to 2.47	25	18.55	1.35	0.82 to 1.88			
<b>Women</b>															
All causes	16	9.70	1.65	0.94 to 2.68	34	25.38	1.34	0.89 to 1.79	50	35.08	1.43	1.03 to 1.82			
All non-violent causes	11	7.90	1.39	0.70 to 2.49	29	23.18	1.25	0.80 to 1.71	40	31.07	1.29	0.89 to 1.69			
Cancer	4	3.40	1.18	0.32 to 3.02	8	8.32	0.96	0.42 to 1.89	12	11.72	1.02	0.53 to 1.79			
Cardiovascular	5	2.08	2.41	0.78 to 5.62	12	7.85	1.53	0.79 to 2.67	17	9.93	1.71	1.00 to 2.74			
Coronary heart disease	2	1.32	1.52	0.18 to 5.48	6	5.19	1.16	0.42 to 2.51	8	6.51	1.23	0.53 to 2.42			
Violent causes	5	1.80	2.77	0.90 to 6.47	5	2.20	2.27	0.74 to 5.29	10	4.01	2.50	1.20 to 4.59			

### Comparison to mortality experience of the Finnish Twin Cohort

There were 126 deaths among the migrants during the follow up period, 76 among men and 50 among women (table 3). For men the observed number of deaths was close to that expected on the basis of the mortality experience of the Finnish Twin Cohort (SMR 1.10; 95% CI 0.86 to 1.35). Among migrants with an estimated duration of stay in Sweden of at most 20 years there was a higher mortality than expected, primarily from all non-violent causes and from cardiovascular disease. For migrants with a longer duration of stay in Sweden mortality from non-violent causes was lower than expected. Including also the person time and deaths during the observation period in migrants returning to Finland gave similar results.

Among women the number of observed deaths in the migrants exceeded that expected based on the mortality experience of all women in the Finnish Twin Cohort Study (SMR 1.43; 95% CI 1.03 to 1.82). This increase concerned primarily mortality from cardiovascular disease and from violent causes. Extending the analyses to include also time in Finland of re-migrants only marginally influenced the results.

### Comparison of first deaths in migrant discordant twin pairs

The numbers of first deaths in twin pairs discordant for migration were similar between the migrants and the non-migrants among men (table 4; 33 of 74 first deaths in migrants). First deaths from all non-violent causes tended to be more common in migrants with an estimated time in Sweden of at most 20 years compared with non-migrant co-twins remaining in Finland. Fewer first deaths overall and from non-violent causes were found in migrants with more than 20 years in Sweden compared with their co-twins.

Also among women, the numbers of first deaths were similar between the migrant and the non-migrant co-twin (27 of 52 first deaths in migrants). First deaths from cardiovascular disease tended, however, to be more common in the migrants than in the co-twins in Finland.

## DISCUSSION

The results of this study, in part based on comparisons within migrant discordant twin pairs controlling for genetic and early childhood factors, suggest that male migrants from Finland to Sweden have an overall mortality experience that is similar to that prevailing in Finland. Mortality from non-violent causes was, however, reduced in migrants with several years in Sweden. Among women an increased mortality from cardiovascular disease in migrants was observed. Consistent with previous observations,<sup>10,11</sup> these results suggest a higher mortality in migrants from Finland to Sweden than in native Swedes in view of the higher mortality in Finland than in Sweden.

The migrants were identified through population registers in Finland and almost all were found also in corresponding registers in Sweden. In order to be registered as a migrant in these registers it is necessary to officially move to Sweden, which is recorded at the latest at employment or when using social security. There are probably certain people in the Finnish Twin Cohort Study who have lived some time in Sweden without registration as a migrant and there may also be migrants that have returned to Finland for some period of time without registration of a new address. This misclassification of migration as well as of the time spent in Sweden is probably unrelated to mortality and probably did not substantially influence associations between migration and mortality. Migration, or return to Finland, that was not registered probably in general concerned short periods of time as a more permanent move, either to take up employment or to use social benefits, would entail an official change of address. The authorities in Finland and Sweden regularly exchange

**Table 4** Number of total first deaths and first deaths of migrants in migrant discordant twin pairs of the Finnish Twin Cohort Study. Percentage (%) of first deaths in migrants compared with all first deaths with 95% confidence intervals (CI). By sex, years in Sweden of migrant and underlying cause of death

Cause of death	≤20 years in Sweden						>20 years in Sweden					
	First deaths			% migrant first deaths of all			First deaths			% migrant first deaths of all		
	All	Migrant	95% CI	All	Migrant	95% CI	All	Migrant	95% CI	All	Migrant	95% CI
	First deaths			% migrant first deaths of all			First deaths			% migrant first deaths of all		
<b>Men</b>												
All causes	37	20	37 to 71	54	20	37 to 71	37	13	20 to 53	35	33	45
All non-violent causes	21	14	43 to 85	67	14	43 to 85	29	9	15 to 51	31	23	46
Cancer	5	4	28 to 99	80	4	28 to 99	5	0	0 to 52	0	4	40
Cardiovascular	13	8	32 to 86	62	8	32 to 86	18	6	13 to 59	33	14	45
Violent causes	16	6	15 to 65	38	6	15 to 65	8	4	16 to 84	50	10	42
<b>Women</b>												
All causes	21	10	26 to 70	48	10	26 to 70	31	17	36 to 73	55	27	52
All non-violent causes	13	7	25 to 81	54	7	25 to 81	27	15	35 to 75	56	22	55
Cancer	5	2	5 to 85	40	2	5 to 85	11	4	11 to 69	36	6	38
Cardiovascular	7	4	18 to 90	57	4	18 to 90	8	7	47 to 100	88	11	73
Violent causes	8	3	9 to 76	38	3	9 to 76	4	2	7 to 93	50	5	42

individual level information on migrants. There was essentially no loss of deaths in the national mortality registers of Finland and Sweden. Thus, information on all cause mortality is comparable between the two countries and this should also basically apply to the broad categories of causes of death used in the analyses of this study. A collaboration regarding classification and coding of causes of death in mortality statistics is going on among the Nordic countries and a recent evaluation showed an 80% agreement in coding of a sample of death certificates using ICD-10 at the three character level between Sweden and Finland.<sup>19</sup>

A strength of this study was the possibility to analyse mortality in migrant discordant twin pairs. In general, the twins of these pairs had a common childhood environment and also shared genetic factors. Questionnaire data from 1975 indicated that migrants and non-migrants were comparable in several respects at the start of the study period. It has been suggested that a low mortality in a migrant population in part may be attributable to a selective return to the country from which the migrants originated.<sup>13</sup> We found that inclusion of the re-migrants had only marginal effect on the mortality of the migrant group. Interpretations of results from this study are, however, limited by the comparatively few deaths during the study period, in particular in comparisons of migrant discordant pairs.

A lower mortality from non-violent causes in men living for many years in Sweden was suggested by our findings and is in accordance with the results of a previous study of myocardial infarction incidence in migrants from Finland to Sweden.<sup>12</sup> These findings could be related to long term changes in environmental and behavioural factors. It might be speculated that a decrease in mortality after several years in Sweden comes from a more full adaptation to the Swedish society with improved standard of living, social relations and networks and perhaps a different lifestyle. It is agreed in migration research that integration of a first generation migrant is a lifelong process, and that only members of second or third generations will be completely integrated.<sup>20, 21</sup> We therefore expect that health consequences for the first generation of migrants will change over time, and that only after 20 years or more—that is, in very long term follow ups—can expect to see the final consequences. The results of this study are consistent with this general perspective, especially for men. Further analyses of the migrant twin cohort are presently being conducted focusing on behavioural and environmental changes after the migration as well as integration in Swedish society. These analyses will contribute to shed additional light on the extent to which migration may influence the long term health of migrants.

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