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**INTERNATIONAL MIGRATION
AND CORONARY HEART DISEASE
EPIDEMIOLOGICAL STUDIES
OF IMMIGRANTS IN SWEDEN**

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ABSTRACT

In today's globalised world, with considerable international migration, knowledge about the health of immigrants is becoming increasingly important. In Sweden, about 13% of the population or over one million persons are born outside the country. Large groups have moved to Sweden from Finland, other Nordic countries, the Baltic States and other Eastern European countries, Western Europe, Turkey, Iran, Iraq, and Latin America.

The aim of the thesis was to describe incidence of myocardial infarction (MI) among foreign-born persons compared to Sweden-born, taking into consideration gender, socio-economic status and time spent in Sweden and to evaluate if the long term trend of decreasing MI incidence in Sweden was present in immigrants to Sweden. In addition, the aim was to analyse survival after a first MI among immigrants and Sweden-born. Furthermore, the aim was to investigate to what extent migration from Finland to Sweden is related to the access to welfare components including education and socio-economic status as well as social support and coronary heart disease (CHD) prevalence. The association between country of birth and incident MI was studied by case control methods. The study base consisted of subjects 30-74 years of age in Stockholm County during the 20 year period 1977-96. Incident cases of first acute MI were identified using registers of hospital discharges and deaths and controls were selected randomly from the study base. In the sampling of controls, sampling fractions were known, which enabled estimates of person time at risk and incidence rates employed in the analyses of time trends. Information on country of birth was obtained from national censuses and from a register on immigration. The study of survival utilised all the cases in the case control study. Cases surviving 28 days were followed with regard to mortality during one year.

In the studies of welfare components and CHD in Finnish twins, the study population consisted of twin pairs of the Finnish Twin Cohort Study where at least one twin had lived one year or more in Sweden. The study included 1,534 migrant or non-migrant subjects and 251 complete twin pairs discordant regarding residency in Sweden. Emigrant twins were compared to non-migrant co-twins regarding welfare components and prevalence of CHD. Data on welfare components and CHD was assessed by an extensive questionnaire administered in 1998 including questions on social factors, health, life style factors and migration history.

Immigrants to Sweden had a higher incidence of first MI including non-fatal as well as fatal cases compared to Sweden-born during the period 1977-96 after adjustment for age and socioeconomic group. Immigrant men had a decreasing time trend of MI incidence during the period 1977-96 of the same magnitude as Sweden-born but among women immigrants had a somewhat less pronounced decline compared to natives. Furthermore immigrants did not have an increased case fatality within 28 days after a first MI compared to Sweden-born persons when differences in socioeconomic group were accounted for. Subjects born in Finland however had an increased case fatality during the first ten years in Sweden among men and after 20 years in Sweden among women. These results suggest that differences in CHD mortality between foreign-born and Sweden-born are primarily due to a higher disease incidence rather than a lower survival. Migration from Finland to Sweden did not substantially improve access to central welfare components for the migrants but a reduced prevalence of CHD in emigrants

compared to non-migrants was observed, taking genetic and early childhood factors into account.

In conclusion the results of this thesis reinforce the impression that immigrants to Sweden, from a number of countries including Finland, are at increased risk of MI compared to native Swedes. Concerning immigrants from Finland this appears to be the case in spite of a certain reduction in CHD prevalence associated with migration to Sweden.

LIST OF PUBLICATIONS

- I. Hedlund E, Lange A, Hammar N. Acute myocardial infarction incidence in immigrants to Sweden. Country of birth, time since immigration, and time trends over 20 years. *Eur J Epidemiol* 2007;22:493-503.
- II. Hedlund E, Pehrsson K, Lange A, Hammar N. Country of birth and survival after first myocardial infarction in Stockholm, Sweden. In review.
- III. Hedlund E, Hammar N, Lange A, Koskenvuo M, Kaprio J. Migrating twins: A study welfare components among Finnish twins living in Sweden and their co-twins residing in Finland. *J Ethn Migr Stud* 2006;32:3-28.
- IV. Hedlund E, Kaprio J, Lange A, Koskenvuo M, Jartti L, Rönnemaa T, Hammar N. Migration and coronary heart disease: A study of Finnish twins living in Sweden and their co-twins residing in Finland. *Scand J Public Health* 2007;35:468-474.

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LIST OF ABBREVIATIONS

AP	Angina pectoris
CHD	Coronary heart disease
CI	Confidence interval
CVD	Cardiovascular disease
FTCS	Finnish Twin Cohort Study
MI	Myocardial infarction
MONICA	Monitoring Trends and Determinants in Cardiovascular Disease
OECD	Organization for Economic Co-operation and Development
OR	Odds ratio
RR	Relative risk
SES	Socio-economic status
SIR	Standardised incidence rate
WHO	World Health Organisation

1 INTRODUCTION

INTERNATIONAL MIGRATION

International migration refers to persons moving across boundaries of nation states and historically as well as currently mankind is on the move. Generally, migration is undertaken to improve living conditions although the extent to which the decision to move is voluntary varies and in many cases the migration is forced upon the migrant. International migrants are usually categorised according to the motives for moving to another place, with labour migrants and refugees as main categories, although migration due to family ties is also common.

With the present-day large international migration, increasing populations of immigrants are living in a new country, permanently or for extended periods of time. This leads to a growing demand for knowledge of the health situation among the foreign born population, as well as of the relative importance of different factors in the migration process in determining immigrants' health status. Immigration to Sweden since the World War II consisted mostly of European labour migrants mainly from Finland, Italy, Yugoslavia and Turkey but also refugees from Hungary. After 1969 the largest immigrant groups have been mainly non-European refugees including persons from Chile, Iran, Iraq, Turkey, Eritrea and Somalia. During the 1990s a large group of refugees from former Yugoslavia came to Sweden.¹ In addition, many immigrants have come to Sweden to be reunited with their families.

Today, about 13% of the Swedish population, or just over 1 million individuals, born in another country live in Sweden. One large immigrant group consists of persons born in Finland. Other large groups have come from other Nordic countries, from the Baltic States, and other Eastern European countries, Western Europe, Turkey, Iran, Iraq, and Latin America.

MIGRATION FROM FINLAND TO SWEDEN

During the period 1945–94, about half a million persons emigrated from Finland to Sweden. A peak in this migration was reached in the years 1969 and 1970 when each year 40,000 persons moved from Finland to Sweden. In 1998, a total of 199,000 persons born in Finland were living in Sweden. Until the early 1950s, the majority of the immigrants were women, but when the migration flow started to increase, the proportion of men increased.² The number of migrants from Finland to Sweden during the period 1965–90 was to a large extent related to the demand for labourers in Sweden.³ However, individuals' motives for emigration were not only expectations for employment and a better job, but movement was also undertaken for educational or family reasons, for better housing, and improved living conditions in general, including self-realisation.³ Generally, emigrants from Finland to Sweden have been relatively young persons with a minimum compulsory education, although female emigrants were more highly educated than males.⁴ Before 1950, migrants from Finland to Sweden were mostly Swedish-speaking, but thereafter the majority were Finnish-speaking, although the proportion of Finnish-speakers remained lower than in the Finnish population as a

whole.² A large proportion of the emigrants were unmarried, but during periods with large numbers of emigrants, the proportion of married or cohabitating persons increased.²

ETHNICITY AND COUNTRY OF BIRTH

Many studies of immigrants' health uses the term ethnicity as an explanatory category but since this term refers to a complex phenomenon including both objective and subjective criteria^{5 6} which is difficult to measure, the more straight forward category 'country of birth' is used in this thesis. Since one nation state may include several ethnic groups and one ethnic group may be present in several nations it is not possible to infer ethnicity from country of birth. Persons who are born in one country and at some point in time have moved to Sweden are compared to persons born in Sweden. This category of persons is denoted as 'immigrants' and consequently this term refer exclusively to persons born outside Sweden who have moved to live in Sweden for an extended period of time.

DIFFERENCES IN CORONARY HEART DISEASE ACROSS COUNTRIES

Coronary heart disease (CHD) is a major cause of chronic illness and one of the leading causes of death in Sweden as well as worldwide with myocardial infarction (MI) as the most common diagnosis.⁷ There are considerable differences in CHD between countries. This has been well documented in the WHO Monitoring Trends and Determinants in Cardiovascular Disease (MONICA) study using standardised definitions and diagnostic criteria which was carried out 1985-95. In this study annual age-standardised event rates for MI in men aged 35-64 covered a 12-fold range from 76 per 100,000 in Beijing, China to 915 in North Karelia, Finland and for women a 8.5-fold range from 30 per 100,000 in Catalonia, Spain to 256 per 100,000 in Glasgow, UK⁸. Many European countries have a lower rate of CHD than Sweden including Italy, Spain, Switzerland, France, Belgium and Germany. Higher CHD mortality rates have been reported from e.g. Eastern Europe.⁹ Also, Finland has a substantially higher incidence and mortality from CHD than Sweden.⁸

There are a number of established risk factors for CHD including low physical activity, hypertension, dyslipidemia, diabetes and overweight. In the INTERHEART study, the association between risk factors and MI was investigated in 52 countries. Dyslipidemia measured by the apolipoproteinB/A-I ratio was the most important risk factor in this study worldwide. Smoking was found to be associated with an almost three-fold risk for MI as was diabetes. Also, hypertension, and abdominal obesity were associated with increased MI. Regular physical activity, daily intake of fruit and vegetables as well as regular alcohol intake were associated with decreased MI prevalence. Furthermore, psychosocial factors, including depression, stress at work or at home, financial stress, experiences of major life events and lack of control, were related to higher MI prevalence.¹⁰

STUDIES OF CORONARY HEART DISEASE IN IMMIGRANTS

Studies of migrants and their descendants have increased our understanding of environmental factors in the aetiology of CHD. Early examples are studies of men of Japanese ancestry in Hawaii and California in the United States. The prevalence of CHD was found to be highest in American-Japanese men living in California followed by those living in Hawaii and lowest in men living in Japan. Acculturation, including cultural upbringing, cultural practice and social interaction, was found to be associated with CHD prevalence and the least acculturated group was found to have a CHD prevalence as low as that in Japan while the most acculturated had a three- to five-fold excess in CHD. It was concluded that conventional risk factors for CHD only partly explained the differences.^{11 12 13}

In many countries immigrants have a higher CHD mortality than natives. This was reported for female immigrants to the United States (US) who have been found to have a higher CHD mortality than natives.¹⁴ Also, higher CHD mortality in immigrants in Australia including among others persons from Italy, Greece and Yugoslavia, compared to Australia-born has been reported.¹⁵ Many studies have been carried out in the United Kingdom (UK) where immigrants from India, Pakistan and Bangladesh are large immigrant groups. South Asian migrants worldwide have increased risk of mortality and morbidity due to CHD.¹⁶ Higher CHD mortality in South Asians in England has been reported from the 1980s until today.^{17 18 19 20} Also from Canada, higher rates of death from CHD in persons born in India, Pakistan, Bangladesh and Sri Lanka compared to Canada-born have been reported.²¹ Not all immigrant groups have an unfavourable CHD level compared to the native population. Lower CHD mortality has been reported in Turkish, Moroccan and Antillean/Aruban immigrants in the Netherlands compared to native Dutch persons²² as well as in Chinese immigrants in Canada.²¹

CORONARY HEART DISEASE IN IMMIGRANTS IN SWEDEN

In Sweden, studies have shown increased morbidity and mortality in CHD among foreign born persons, compared to Swedish-born persons, in particular for certain countries of origin, including Finland. In a case-control study of Finnish immigrant men 1974-76 they were found to have a relative risk (RR) of 1.7 for fatal and non-fatal MI compared with Sweden-born and after 20 years in Sweden the risk was still 1.3.²³ In a study in Sweden of the influence of country of birth on mortality during the years 1979-1993 it was reported that female immigrants from Finland and from Eastern Europe had a higher CHD mortality with relative risks of 2.2 and 2.8 respectively.²⁴ Higher relative risk for first admission to hospital due to CHD 1997-98 was found in immigrants from Finland (RR men: 1.7/women 1.8), Southern Europe (RR 1.3/1.4), Poland (RR 1.9/1.6), Bosnia (RR 1.7/2.5), Turkey (RR 2.2/2.1), Iran (RR 1.9/2.1) and from Iraq (RR 2.1/2.3). Higher risk was also found in men from Eastern Europe (RR 1.2) and from Asia (RR 1.8). It was concluded that the differences were not explained by level of education or employment status.²⁵ A study of incidence in CHD including first admission to hospital and mortality, showed higher incidence rates in Finland-born men (SIR 1.5), men born in Central Europe (SIR 1.3), in other Eastern European countries (SIR 1.6) and in Turkey (SIR 2.0). Higher incidence was also found in women from Finland (SIR 1.5), Central Europe (1.2), other Eastern European countries (SIR 1.8) and from Turkey (SIR 1.8). Lower incidence rates were found in women from the Bal-

tic States (SIR 0.7), Southern Europe (SIR 0.9) and from other Western European countries (SIR 0.9).²⁶

CORONARY HEART DISEASE TIME TRENDS IN IMMIGRANTS

A decline in the incidence and mortality from coronary heart disease during the last 25 years has been present in Sweden and in most other industrialised countries^{27 28 29 30 31} although unchanged or increasing trends have been reported from some countries.^{32 33} Little is known about to what extent declining trends of CHD also applies to the immigrant populations. In Canada, rates of death from ischemic heart disease declined in South Asian and Chinese immigrants during the period 1979-93.²¹ During the period 1970-92 mortality due to CHD declined more in Caribbean immigrants in the UK than in the native population and also, immigrants from South Asia showed a decline, although smaller than in natives.¹⁹ In Sweden, one study of time trends in CHD has been carried out. It was based on in first admissions to hospital due to CHD in persons aged 35-74 comparing incidence rates 1991-92 to incidence rates 1997-99. A declining trend was found in men born in Sweden, Finland and OECD countries (USA, Canada, Australia, New Zealand, Japan, Western Europe except for Finland and Southern Europe). In women only those born in Africa showed a declining trend while an increasing trend was found in women born in Southern Europe, in Turkey and in Iran.³⁶

A higher CHD mortality in immigrants compared to natives may be due to higher incidence but may also be a result of lower survival after a CHD event. Only a few studies have analysed survival after myocardial infarction among immigrants compared to the population of the country of immigration and the results have not been uniform. Higher case-fatality has been reported for South Asians in the United Kingdom³⁷ and Canada³⁸ while lower case-fatality for South Asians in the UK has been shown.³⁹ Also, it has been reported that the case-fatality rate is about the same for South Asians as for non-South Asians in Canada.⁴⁰ In Sweden, no studies of survival after MI have been carried out.

INFLUENCE OF MIGRATION ON CORONARY HEART DISEASE RISK

A higher risk of CHD among immigrants compared to natives may be due to the immigrants' living conditions and social position in the country of immigration, often characterised by lower socio-economic status, lower education and more unemployment than among natives. Psychosocial stress as a result of migration and of problems related to the integration process may also be a contributing factor. The elevated risk may also be a reflection of the higher incidence in the country of origin.

In general, studies comparing CHD in migrants from countries with a lower CHD risk, than in the population of the country of immigration, have commonly shown an increased risk of CHD in the migrants after several years in the country of immigration, representing an adjustment to the prevailing disease pattern.^{11 12 13 20} From the point of view of prevention, studies of migrant populations moving from a high risk to a low risk area could suggest ways in which to reduce disease occurrence. The migration from Finland to Sweden is potentially an example of this. This possibility was explored in the present thesis. Twin pairs of the Finnish Twin Cohort Study where one twin had moved to Sweden and the co-twin had remained in Finland provided an opportunity to

study effects of migration, taking into account genetic factors and childhood environment.

One aim of this thesis was to describe incidence in and survival after CHD in immigrants in Sweden in general. Since increased mortality may be due to both higher incidence and lower survival, this is of importance for the interpretation of CHD mortality differences between immigrants and natives. Immigrants from Finland are a large immigrant group characterised by higher CHD levels than Sweden-born. In this thesis immigrants from Finland are also studied to explore in what way migration from Finland to Sweden may influence social factors associated with the occurrence of CHD, including education, socio-economic status, employment and social support as well as CHD prevalence.

2 AIMS OF THE THESIS

- To describe incidence of MI among foreign-born persons compared to Sweden-born, taking into consideration gender, socio-economic status and time spent in Sweden. In addition, the aim was to evaluate if the long term trend of decreasing incidence of MI in the Swedish population since the early 1980's was also present in immigrants to Sweden. (Study I)
- To analyse mortality early and during the first year after a first myocardial infarction among immigrants and Sweden-born living in Stockholm County 1985-96 taking into consideration gender, socio-economic status, and time spent in Sweden. (Study II)
- To investigate to what extent migration from Finland to Sweden is related to the access to welfare components including education, socio-economic status and social support. (Study III)
- To analyse to what extent migration from Finland to Sweden is related with CHD prevalence. (Study IV)

3 SUBJECTS AND METHODS

The thesis includes four studies illustrating different aspects of CHD among immigrants in Sweden. Study I is a population-based case-control study giving a description of the incidence of MI among foreign-born persons taking into consideration country of birth, gender, socio-economic status and time spent in Sweden. It also describes the trend over 20 years of MI incidence in the Swedish population comparing Sweden-born to foreign-born. The study base consisted of the population of Stockholm county aged 30-74 during 1985-96. Study II utilises the cases in the case-control study comparing mortality after myocardial infarction among Sweden-born and foreign-born living in Stockholm County 1985-96. Study III and IV are cross-sectional studies of Finnish twin pairs in the Finnish Twin Cohort Study where at least one of the twins had lived for some time in Sweden. Study III describes how emigration affects access to central welfare components, including several known risk factors for CHD and study IV associations between migration and prevalence of CHD. In comparisons within migration discordant twin pairs genetic and childhood factors were taken into account. In the studies based on the Finnish Twin Cohort study also former emigrants, who returned from Sweden to Finland, were included.

THE POPULATION-BASED STUDIES

STUDY I

The study base consisted of men 30-74 years of age in Stockholm County during the 20 year period 1977 to 1996. The association between country of birth and incident MI was studied by case control methods. For the period 1977-84 data was compiled in the late 1980's, while for the years 1985-96 data was compiled more recently and in a similar fashion but with a more extensive sample of controls. The outcome, incident cases of acute MI in the study population were identified using registers of hospital discharges and deaths in accordance with a previously developed and evaluated method found to be reliable for epidemiological purposes.^{41 42} Recurrent cases of myocardial infarction were excluded using information from hospital discharge registers on previous infarctions going back to 1972. In total, we identified 21,608 incident first MI cases 1977-84 and 24,758 cases 1985-96. Controls were selected randomly from the study base using registers of the total population of Stockholm County on December 31st each year 1976-96. In the sampling of controls we stratified by gender, age (five-year age groups) and calendar year. By using a dynamic study population controls reflect changes in the ethnic composition of the population during the study period. For the period 1977-84 we selected two controls for each case which amounted to 60,940 controls. Controls were also selected for recurrent cases of MI and these controls were retained although the recurrent cases were not used in the present study. For the period 1985-96 we selected a total of 1,500 controls per stratum corresponding to 345,587 controls after exclusion of controls with a history of MI. For the period 1977-84 information on previous MI was not available for the controls. In all, 46,365 cases were identified and 406,527 controls were selected.

Table 1: Number of cases and controls in countries or regions of birth.

Country of region of birth	No of cases	No of controls
Sweden	39404	335138
Finland	2590	24650
The Baltic States: Estonia, Lithuania, Latvia	526	2848
Other Nordic countries: Denmark, Norway, Iceland	725	5288
Former Yugoslavia: Bosnia-Herzegovina, Yugoslavia, Croatia, Macedonia	163	2667
The Netherlands	349	56
Poland	303	3166
Eastern Europe: Albania, Bulgaria, Romania, Czechoslovakia	150	1475
Western Europe: Belgium, Switzerland, Austria,	117	1221
North America: USA, Canada	104	1282
Sub-Saharan Africa: Angola, Botswana, Burundi, Central African Republic, Comorian, Equatorial Africa, Ivory Coast, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Cameroon, Cape Verde, Kenya, People's Rep of Congo, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, Somalia, Sudan, Swaziland, South Africa, Tanzania, Chad, Togo, Uganda, Zaire, Zambia, Zanzibar	27	1352
North Africa: Algeria, Libya, Morocco, Tunisia	25	70
South Asia: India, Pakistan, Bangladesh	67	773
South East Asia: Burma, Kampuchea, Philippines, Hong Kong, Indonesia, Japan, People's Rep of China, China (Taiwan), North Korea, South Korea, Laos, Malaysia, Singapore, Sri Lanka, Thailand, Dem Rep Vietnam, Rep Vietnam	48	1532
Other Mediterranean countries: Italy, Portugal, Spain, France	192	2317
Greece	125	2044
Other South American and Caribbean countries: Argentina, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, Jamaica, Trinidad & Tobago, Honduras, Nicaragua, Panama, Haiti, Mexico, Paraguay, Peru, Surinam, Uruguay, Venezuela, Barbados, Cuba, Dominica	40	1249
Chile	2042	66
Other Middle Eastern countries: Egypt, Israel, Jordan, Saudi Arabia, Yemen, Kuwait, Lebanon, Palestine, Afghanistan	50	867
Turkey	217	2668
Former Soviet Union:	113	1004
Foreign-born, country unknown	394	1600
Total	406527	46365

STUDY II

Study II was based on the same cases as Study I. The study population consisted of all cases of first myocardial infarction among persons 30-74 years old in Stockholm County during the 10 year period 1985-96. For a description of identification of cases see Study I. All cases surviving the acute phase were followed with regard to mortality during at least one year by means of the National Cause of Death Register. In this study we analysed four different outcomes associated with a first myocardial infarction: 1) Death outside hospital; 2) Death within 28 days after admission to hospital; 3) Death

within 28 days after disease onset, including outcome 1) and 2) (case fatality); 4) Death within one year after disease onset in those who survived the first 28 days.

Study I & II: Information on migration and socio-economic status

Information on country of birth, citizenship, migration, and socio-economic status 1968-98 was acquired from national censuses of the years 1970 and 1975 (only Study I) as well as for the years 1980, 1985 and 1990 (Study I & II). When the number of subjects was too small we aggregated subjects into categories of country of birth based on geographical proximity. Data on time spent in Sweden was acquired from the Swedish National register on immigration and emigration.

Statistics Sweden transformed the occupational codes for censuses in 1985 and 1990 to the Nordic occupational code of 1980.⁴³ In the Swedish system for classifying socio-economic group subjects are subdivided into manual workers, non-manual employees and self-employed. We classified socio-economic group for cases and controls primarily from the preceding census. If the subject was not employed at that census we used information from the next previous census back in time. In the 1970 and 1975 censuses there was no classification of socio-economic group performed by Statistics Sweden. We carried out a classification of socio-economic group for these years according to the same principles as in the census of 1980 and these data were used in Study I.

Statistical methods: Study I

The association between country of birth and first acute MI was estimated by logistic regression computing odds ratios, adjusting for age group (five-year) and calendar year (four-year). In these analyses, we used native Swedes as reference group. In view of the study design the odds ratios may be interpreted as relative risks or estimates of incidence density ratios and will be denoted relative risks (RR) throughout the text. Analyses including socio-economic status were restricted to those groups of foreign-born where data on socio-economic status were available for at least 70 per cent.

For the analyses of time trends incidence rates were estimated by calendar year time period, gender, age and country of birth. This was possible since sampling fractions were known in the sampling of controls using population registers covering all subjects in the study base. The person time at risk used in the incidence estimates was derived using the prevalence of the immigrant group and socio-economic group among the controls and the sampling fraction of controls for each stratum (age, gender and calendar year). Age-standardised (five-year age groups) incidence rates were calculated by two-year calendar periods for different categories of immigrants and for all Sweden-born persons respectively. The age distribution for all persons included in the study was used in the age standardisation. We estimated the average annual change in incidence of first acute MI during the study period by Poisson regression, adjusting for secular changes in the age distribution. Random variation was accounted for by computing 95% confidence intervals. We used the statistical software Stata 9 throughout the analyses.

Statistical methods: Study II

Differences and means were analysed by t-test or chi-square-test. The association between country of birth and death after first acute myocardial infarction was estimated by odds ratios through logistic regression, adjusting for age (five-year age groups), cal-

endar year and hospital. In the regression analyses we used persons born in Sweden as reference group. Random variation was accounted for by 95 % confidence intervals. We used the statistical software Stata 9 throughout the analyses.

THE FINNISH MIGRANT TWIN STUDIES

Study III and IV were based on data on twin pairs included in the Finnish Twin Cohort Study (FTCS). The FTCS was started in 1974 and includes all same-sexed Finnish twin pairs born before 1958 where both twins of the pair were alive in 1975.⁴⁴ The study population consisted of all pairs aged less than 75 years old, where at least one twin had lived for a minimum of one year in Sweden in 1998—in all 1,083 pairs (543 male and 540 female pairs), in all 2,166 persons. Migrants to Sweden in the FTCS were identified using national population registers in both Finland and Sweden. Information about migration from Finland was obtained from the Population Register of Finland. For the migrants to Sweden, the Swedish personal identification number was obtained from registers at tax authorities in Sweden. Data on return migration 1968–98 were acquired from a migration register of Statistics Sweden. Additional information about residency in Sweden was obtained from the 1960 census and from registers of the total population of Sweden for 1968, 1978 and 1995.

Data regarding socio-economic status, living conditions, lifestyle factors and health had previously been collected via questionnaires on three occasions, 1975, 1981 and 1990. The response rate of the 1975 questionnaire was 89 per cent; although for migrants to Sweden the response rate was lower (54%). Zygosity has been established for 93 per cent of the pairs, based on questionnaire items about similarity during childhood.⁴⁵

The Questionnaire

A questionnaire was mailed in 1998 to those migrant twin pairs of the Finnish Twin Cohort satisfying the criteria mentioned above. The questionnaire was first constructed in Swedish, then translated into Finnish, and finally translated back to Swedish. This version was compared to the original Swedish version to ensure comparability between the two language versions. Also, in the data collection, the questionnaire was available in both languages. The questionnaire included questions about personal circumstances and family relations, a complete migration history with all addresses since childhood including internal as well as international migration, life in Sweden (where relevant), education and working life, health, life events and social support, food and drinking habits, smoking habits and physical activity.

The categorisation of the respondents as emigrants, ‘non-migrants’ (never migrants) or returnees, and the estimation of their time spent in Sweden, were based on the answers to the questionnaire about places of residence during the life course. ‘Never migrants’ were persons who had lived in Finland their whole life. Some subjects who had lived less than a year in Sweden were also categorised as ‘never migrants’. ‘Emigrants’ were persons who lived in Sweden in 1998 and had lived there for at least one year. ‘Returnees’ were in Finland in 1998 but had lived at least one year in Sweden. Twin pairs consisting of one emigrant and one never migrant were denoted as ‘migration discordant pairs’. The term ‘migrants’ is used to denote the category consisting of both emigrants and returnees.

Indicators of coronary heart disease

A measure of prevalent CHD was derived from the 1998 questionnaire and consisted of a combination of angina pectoris (AP) and a history of myocardial infarction (MI). AP and MI were measured by items asking if a physician ever told the respondent that s/he had the disease in question. AP was also measured by Rose's AP questionnaire,⁴⁶ where subjects were classified as having AP if they reported chest pain during physical effort. To be defined as typical symptoms of AP, the pain had to be located in the upper part of the chest or in the left part of the chest and in the left arm, and it had to be relieved within 10 minutes after effort. To obtain an indicator of prevalent CHD, we used a report of MI or AP diagnosed by a physician or a positive diagnosis of AP according to the Rose' questionnaire.

To assess the sensitivity and specificity of this indicator we used clinical information for the 76 male twin pairs that took part in a detailed clinical examination. These twin pairs were discordant for duration of residency in Sweden, and one twin had lived in Sweden 20 years or more and the co-twin always lived in Finland. The clinical examination focused on markers of subclinical atherosclerosis and biochemical risk factors for CHD.^{47 48 49} The examination included interviews, anthropometric measures, blood samples, ergometry test with echocardiography, and determination of carotid artery intima-media thickness and brachial artery endothelial function by ultrasound. Prevalent CHD in the clinical examination was considered present if there was a history of MI and/or pathological Q-waves in resting ECG, indicating definitive MI, or wall motion abnormalities in cardiac ultrasound after an exercise test or definitive occlusive atherosclerosis based on coronary angiography.

Current smoking, low physical activity,⁴⁶ height, and weight were assessed by questionnaire items. Body mass index (BMI) was computed from weight and height as $\text{weight(kg)/height(m)}^2$. Self-reported data on diabetes as well as height and weight were in close agreement with corresponding data assessed in the clinical examination, where diabetes was defined as use of antidiabetic medication or diabetes according to an oral glucose tolerance test using WHO 1999 criteria.

Access to welfare resources was analysed on the basis of data on education, socio-economic status, employment, marital status, and different aspects of social support. One item in the questionnaire, asking respondents to state their highest completed formal education out of five different alternatives, assessed the level of education. Socio-economic status was categorised into eight categories following a system used in Swedish censuses by Statistics Sweden⁴³ based on current or, for subjects not employed in 1998 former main occupation. In the analyses, subjects were categorised as working class or not. Education was assessed in six levels and in the analyses the subjects were classified as having only elementary or compulsory schooling or more than this.

We based our measurement of employment on an item where the respondents stated their employment status either as working, housekeeping, retired, studying, unemployed or something else. To assess the experience of ever having been unemployed we used an item where the respondents were asked if they had been unemployed during the last year, sometimes or never. The respondents were furthermore asked to evaluate their qualifications in relation to their job. To assess the social dimension of working life the

respondents were asked to rate to what extent they considered themselves to be rooted in their working place or school, rating on a four-grade scale.

Marital status was assessed by two items. In the first, respondents were asked to state their current marital status as single, married/cohabitating, divorced/separated or widow/widower. In the second item, the respondents were asked to report if they had ever experienced a marital separation or an equivalent event. To be married or cohabitating refers to the situation in 1998, while being divorced refers to an experience at any time during their life. This means that a person could be currently married in 1998 but also divorced. We also analysed the proportion that had children and asked the respondents to what extent they had strong feelings of attachment to their relatives.

Social support was measured by a series of questions forming two scales measuring availability of social network and availability of attachment.^{50 51 52} The measure of social network was based on six items dealing with how many social contacts respondents have of four different kinds. The measure of availability of attachment was based on six items assessing the subjects' access to intimate friendship. A feeling of loneliness was assessed by the question: Do you feel lonely right now? In sum, marital status, social support, the feeling of loneliness, and the feeling of belonging to relatives and to workmates were considered as indicators of social welfare.

To assess the subjects' own evaluation of the effect of the migration we asked respondents if they believed their situation would have been better, worse, or neither better nor worse concerning work and income, family and friends and in general, had they never migrated.

Index measuring integration in the Swedish society

Integration into Swedish society may be regarded as having access to welfare in a wide sense. One dimension of integration includes interaction with one's ethnic group on both personal and symbolic level, which may constitute a basis for a feeling of belonging to a certain ethnic and national context. It is reasonable to assume that integration to the country of immigration may modify how the emigration affected the emigrants. A factor analysis of the items in the questionnaire dealing with the respondents' relation to Finland and Sweden and to Finns and Swedes was made to capture different dimensions of the integration in Sweden.

The factor analyses were performed in the statistical software SPSS 11.5 using principal axis factoring and principal component analysis. To make it possible to use the index in the analyses of emigrants as well as of returnees, only items in the questionnaire distributed to both groups were included. Items dealing with language use (Finnish or Swedish) were excluded because stratified analyses were performed to estimate the effect of language.

Irrespective of factoring method, two distinct but correlated factors were generated in the factor analysis. One factor was interpreted as a subjective feeling of belonging to Sweden, while the other could be described as social and symbolic interaction with fellow Finns in Sweden. The factor we based our index of integration on was comprised of the following items: What is your citizenship?; In which country do you feel most at home?; How often do you visit Finland?; Would it be easy for you to leave Sweden?;

In the questionnaire distributed to returnees, the two last items were related to the situation when they lived in Sweden.

The final index was constructed by making a summery scale of the dichotomised answers to these items. The index scale goes from 1 to 5 where 1 stands for low integration to the Swedish society and 5 means high integration. Those with low integration (1 point) have Finnish citizenship, feel most at home in Finland, do visit Finland often, and think that it would be easy to leave Sweden, while those who score 5 report the opposite situation: Swedish citizenship, feel most at home in Sweden, seldom visit Finland, and state that it would be difficult to leave Sweden. The index was dichotomised into a low (1 to 3 on the original index) and a high level (4 to 5 on the original index) of integration in the Swedish society. To measure a subjective aspect of integration in the Swedish society, which is not captured by measuring access to welfare, we used an indicator of the extent to which the respondents were situated in a Swedish or a Finnish context. Of course, this does simplify a complex process whereby immigrants find a way to manage their lives in a new context. To measure dimensions of social life outside the actual context is always problematic.

Statistical methods

Data were analysed pairwise as well as disregarding pair status. Pairwise percentage differences with 95% confidence intervals were calculated, comparing emigrants and never migrants in the migration discordant pairs, using a matched pair analysis.⁵³ The analysis disregarding pair status including all subjects was based on the three groups: emigrants, never migrants and returnees. We report age-adjusted percentage differences with 95% confidence intervals.⁵⁴ All analyses were performed in the statistical package Stata 8.⁵⁵

For reasons of brevity, education and socio-economic status were dichotomised in the analyses. High education was defined as gymnasium or university education. Low socio-economic status was defined as being a manual worker. Before dichotomisation more detailed analyses were performed and these gave, in general, similar results. The variable measuring perceived over-qualification in relation to work was dichotomised into feeling 'over-qualified' or 'not over-qualified' (including those who perceived their qualifications as adequate). The three-grade measure of feeling lonely was categorised into 'feeling lonely' and 'not feeling lonely'. The four-graded measurements of the feeling of belonging to relatives and to workmates and place of work were dichotomised into having these feelings or not. The respondents were categorised as either feeling this way, at least to some extent, or lacking this tie to their family.

The respondents were further categorised as having either a relatively large or a more limited social network. A large social network was defined as either lacking or having a limited number of available persons in no more than two of the categories mentioned. Lack of attachment was defined as a total lack of ties, either close or more distant, to other persons. Also, the integration index was categorised into a high and a low level of integration. High integration was defined as the presence of only one of four different characteristics included in the index, which should be interpreted as having a very low interaction with fellow Finns and a low feeling of belonging to a Finnish context.

4 RESULTS

STUDY I

Overall, foreign born men had a higher incidence of first MI (Table 1) 1977-96 than men born in Sweden (RR=1.17; 95% CI 1.13-1.21). Men born in Finland, other Nordic countries, Poland, Hungary, the Netherlands, Turkey, Syria, and South Asia had a higher incidence than native Swedes, while men born in Latin America, South-East Asia, North Africa, and Sub-Saharan Africa showed a lower incidence.

Also among women, foreign born subjects had a higher incidence of MI (Table 2) than Sweden-born (RR=1.15; 95% CI 1.09-1.21). Women born in Finland, Poland, East Europe, Turkey, Syria, Iraq, and South Asia showed a higher incidence during the period, while women born in North America, Greece, and Chile had a lower incidence than Sweden-born.

Analyses stratified for the time since immigration, showed that foreign-born persons overall had an elevated incidence already during the first year in Sweden. This increase was present during the following nine years and was still noticeable after more than 20 years in Sweden. This was found for subjects born in Finland, other Nordic countries, Eastern Europe and Middle Eastern countries in both genders and among women born in Africa. Among men, subjects born in Mediterranean countries showed an increased incidence during the first year in Sweden but not later and subjects born in Asia also had an elevated incidence during the first year which seemed to be present also after 19 years in Sweden.

During the 20 year period 1977-96 the incidence of MI among foreign born persons mainly followed the trend in the general Swedish population (Figure 1). The average annual reduction in incidence among immigrant men was 2.5%, (95% CI 2.0-3.0) a change of the same magnitude as in Sweden-born men, while immigrant women showed an average decrease of 1.1% (95% 0.3-1.8 CI) per year compared to 1.6% (1.3-2.0 95% CI) per year in Swedish-born women.

Table 1: Relative risk (RR) of first event myocardial infarction in different sub-populations based on country of origin in Stockholm country 1977-96. Men 30-74 years.

Country or region of birth	No of cases	RR ¹ 77-96	95% CI	RR ² 77-96	95% CI
Sweden	27129	1			
Foreign born	4535	1.17	1.13-1.21	1.17	1.13-1.22
Finland	1661	1.48	1.40-1.56	1.38	1.29-1.47
Other Nordic countries	478	1.18	1.07-1.31	1.22	1.09-1.36
Baltic countries	361	1.11	0.99-1.25	1.15	1.01-1.31
Former Soviet Union	75	1.02	0.79-1.32	n/a	
Former Yugoslavia	133	1.02	0.85-1.23	1.08	0.87-1.32
Poland	186	1.20	1.02-1.40	1.16	0.96-1.40
Hungary	148	1.24	1.03-1.48	1.24	1.02-1.51
Other Eastern European countries	110	1.19	0.96-1.46	1.26	1.00-1.59
West Germany	280	1.02	0.89-1.16	1.07	0.93-1.23
Great Britain	48	0.82	0.61-1.10	0.93	0.67-1.28
The Netherlands	51	1.64	1.20-2.25	1.85	1.34-2.57
Other Western European countries	89	0.90	0.72-1.13	1.00	0.79-1.26
Greece	118	1.09	0.90-1.33	1.10	0.88-1.36
Other Mediterranean countries	161	0.96	0.81-1.13	0.97	0.81-1.16
Turkey	166	1.48	1.40-1.56	1.40	1.15-1.70
Syria	36	1.50	1.05-2.13	n/a	n/a
Iran	64	0.86	0.67-1.11	n/a	n/a
Iraq	25	0.74	0.50-1.12	n/a	n/a
Other Middle Eastern countries	38	0.94	0.67-1.31	n/a	n/a
North America	83	0.93	0.74-1.18	0.98	0.75-1.28
Chile	51	0.68	0.60-1.07	0.64	0.46-0.90
Other Latin American and Caribbean countries	29	0.64	0.44-0.93	0.74	0.51-1.08
South Asia	52	1.50	1.12-2.00	1.49	1.06-2.08
South East Asia	34	0.64	0.45-0.91	n/a	n/a
African countries					
North Africa	23	0.61	0.40-0.92	0.59	0.37-0.95
Sub-Saharan Africa	13	0.26	0.15-0.45	n/a	n/a

¹ Adjusted for age and year ² Adjusted for age, year and socio-economic status

Table 2: Relative risk (RR) of first event myocardial infarction in different sub-populations based on country of origin in Stockholm country 1977-96. Women 30-74 years.

Country or region of birth	Number of cases	RR ¹ 77-96	95% CI	RR ² 77-96	95% CI
Sweden	10144	1			
Foreign born	1810	1.15	1.09-1.21	n/a	n/a
Nordic countries					
Finland	842	1.38	1.27-1.49	1.20	1.09-1.32
Other	203	1.07	0.92-1.24	1.14	0.95-1.38
Baltic countries	125	1.01	0.83-1.22	1.08	0.85-1.38
Former Soviet Union	35	1.01	0.70-1.45	n/a	n/a
Former Yugoslavia	27	0.85	0.57-1.25	n/a	n/a
Poland	100	1.43	1.16-1.77	1.20	0.89-1.63
Hungary	37	0.99	0.70-1.40	1.01	0.65-1.57
Other Eastern European countries	36	1.58	1.16-2.17	0.91	0.53-1.54
West Germany	127	0.87	0.72-1.05	0.86	0.68-1.08
Great Britain	12	0.68	0.37-1.24	1.01	0.50-2.01
The Netherlands	3	0.48	0.15-1.53	0.77	0.24-2.49
Other Western European countries	24	0.98	0.64-1.50	1.00	0.58-1.70
Greece	6	0.29	0.13-0.64	n/a	n/a
Other Mediterranean countries	25	0.76	0.50-1.15	0.85	0.52-1.39
Turkey	49	1.38	1.27-1.49	n/a	n/a
Syria	16	2.06	1.22-3.46	n/a	n/a
Iran	22	1.01	0.65-1.55	n/a	n/a
Iraq	12	2.15	1.18-3.91	n/a	n/a
Other Middle Eastern countries	12	1.15	0.81-1.63	n/a	n/a
North America	18	0.52	0.32-0.84	0.71	0.41-1.23
Chile	15	0.52	0.31-0.87	n/a	n/a
Other Latin American and Caribbean countries	10	0.62	0.33-1.17	n/a	n/a
Asia					
South Asia	15	2.06	1.20-3.54	n/a	n/a
South East Asia	13	0.65	0.37-1.15	n/a	n/a
Africa					
North Africa	2	0.44	0.11-1.78	n/a	n/a
Sub-Saharan Africa	14	1.42	0.83-2.44	n/a	n/a

¹ Adjusted for age and year ² Adjusted for age, year and socio-economic status

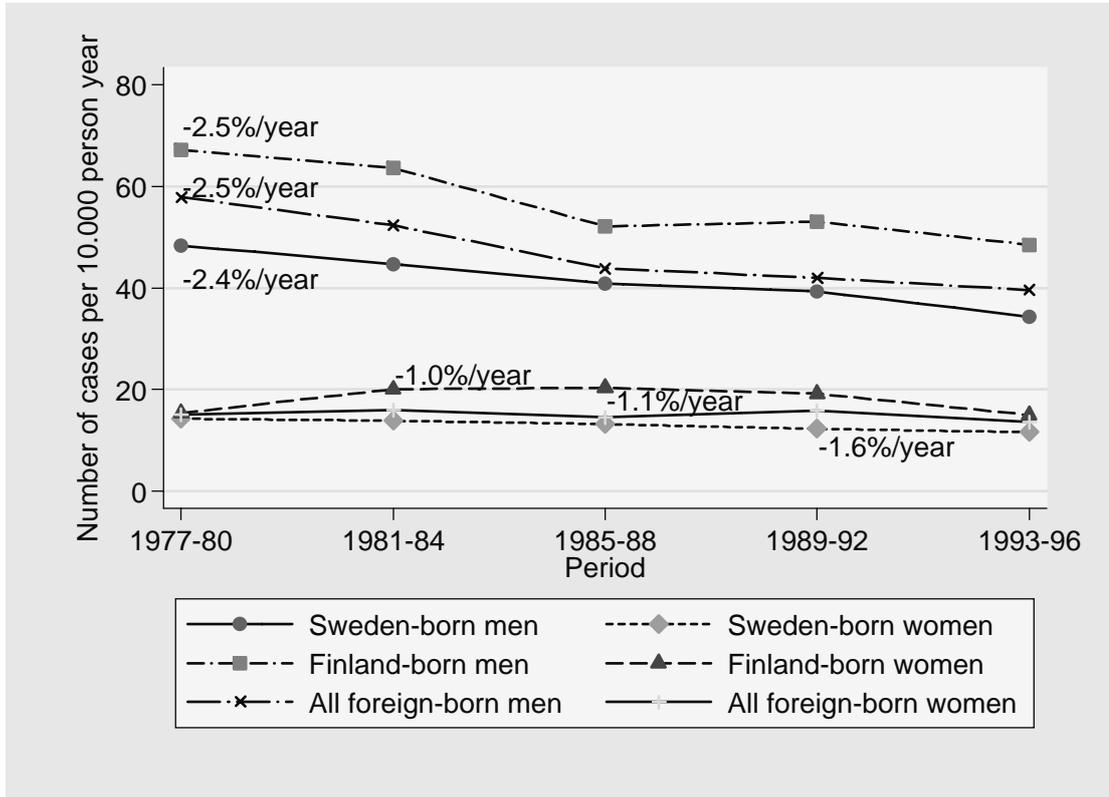


Figure 1: Number of cases of first AMI and average annual change in men and women in Stockholm County 1977-96. Persons born in Sweden, Finland and all foreign-born.

STUDY II

Foreign-born subjects, including persons born in Finland, were generally younger than Sweden-born subjects (mean age 60.5 versus 64.1 years, p-value 0.001) and were more often manual workers. Fatal cases among foreign-born persons excluding Finland-born were less often autopsied (p-value 0.001) (Table 3).

Table 3: Patient characteristics

	MEN			WOMEN		
	Sweden-born	Foreign-born excluding Finland-born	Finland-born	Sweden-born	Foreign-born excluding Finland-born	Finland-born
N	14694	1952	1057	5571	563	680
Hospital treated %	78.3	82.2	77.9	80.1	80.0	79.0
Autopsy % of fatal cases	80.3	72.3	76.7	80.3	67.9	77.0
Socio-economic status %						
n with data on SES	11921	1431	786	3672	346	361
I Higher-level non-manual workers and self-employed	23.0	23.0	13.5	7.1	9.9	6.1
II Low- and intermediate-level non-manual workers	38.1	27.6	22.0	44.3	36.0	29.6
III Manual workers	38.9	49.4	64.5	48.6	54.1	64.3

The proportion of male cases that died within 28 days and one year after disease onset respectively was 34% and 39 % in subjects born in Sweden, 33% and 37 % in subjects born in Finland and 25% and 30% in other foreign born men. The corresponding proportions in women were 35% and 41 % in Sweden-born women, 37% and 43% in Finland-born and 33% and 38 % in other foreign-born.

Taking differences in age, and calendar year into account, the case fatality among men 1985-96 tended to be lower among foreign-born overall than among Sweden-born subjects (OR 0.91; 95% CI 0.83-1.00) (Table 4). This was primarily found in foreign-born except those born in Finland (OR 0.78; 95% CI 0.70-0.88). Men born in Finland had a higher case fatality than Swedish born men (OR 1.17; 95% CI 1.07-1.35). These differences were present in deaths outside hospital as well as in hospital treated cases. A lower case fatality was present in men from Western European and Asian countries and was indicated also for male immigrants from other regions.

Among women, the case fatality was similar in foreign-born overall compared to Swedish born (OR 1.05; 95% CI 0.92-1.20) (Table 5). A lower case fatality was seen in women from Eastern European countries (OR 0.68; 95% CI 0.48-0.97), while women from Finland tended to have a higher case fatality (OR 1.19; 95% CI 0.99-1.43). These differences were mainly associated with differences among hospital treated cases. There were only small difference in death outside hospital between Sweden-born and foreign-born with the possible exception of a higher mortality in women from Asian countries but this difference was based on very few cases (n=8). When controlling for

socio-economic status the odds ratios generally became lower (Table 6). As a result of this the difference between Finland-born and Sweden-born basically disappeared and the difference between other foreign-born and Sweden-born increased.

For Finland-born men, an increase in case fatality was present during the first ten years in Sweden but among those who had been in Sweden 20 years or more, the case fatality was close to that for Sweden-born (OR 0.92; 95% CI 0.66-1.27) after adjustment for socioeconomic group. Among women born in Finland an increased early mortality appeared to be present only after 20 years in Sweden (OR 1.28; 95% CI 0.96-1.71). In other foreign-born men and in women the case fatality did not seem to change markedly with time spent in Sweden and among men a substantially reduced early mortality was seen in immigrants with more than 20 years in Sweden (OR 0.66; 95% CI 0.52-0.82).

Among survivors of the first 28 days after a first myocardial infarction, foreign-born men had a higher one year mortality (OR 1.22; 95% CI 1.01-1.47) compared to Sweden-born men (Table 7). This increase was present in men from Finland as well as in other foreign-born men. Men from other Nordic countries than Sweden and Finland had an almost two-fold increase in the one-year mortality (OR 1.87; 95% CI 1.22-2.87). When controlling for socioeconomic status the difference between natives and non-Finnish foreign-born disappeared (OR 1.05; 95% OR 0.81-1.38) while the increased mortality in men born in Nordic countries remained increased (Finland OR 1.26; 95% CI 0.88-1.81 and other Nordic countries OR 1.95; 95% CI 1.21-3.14). Among women essentially no difference between foreign-born and Sweden-born with regard to one-year mortality was seen (all foreign-born OR 0.90; 95% CI 0.60-1.35).

Table 4: Case fatality (death \leq 28 days) in cases with a first myocardial infarction by country of birth. Men 30-74 years in Stockholm county 1985-96. Odds ratio (OR) with 95% confidence interval (CI)

Country or region of birth	n	Death out of hospital			Death within 28 days in hospital treated cases			Death within 28 days		
		No of deaths	OR ¹	95% CI	No of deaths	OR ²	95% CI	No of deaths	OR ¹	95% CI
Sweden	14694	3184	1		1786	1		4970	1	
Foreign born	3009	562	0.96	0.97-1.06	257	0.85	0.73-0.98	841	0.91	0.83-1.00
Foreign born except born in Finland	1952	328	0.85	0.75-0.97	148	0.71	0.59-0.85	498	0.78	0.70-0.88
Finland	1057	234	1.17	1.00-1.37	109	1.17	0.95-1.46	343	1.17	1.07-1.35
Other Nordic countries	291	56	0.87	0.64-1.16	32	0.90	0.61-1.32	88	0.87	0.67-1.12
Baltic countries	180	47	1.26	0.90-1.76	15	0.64	0.37-1.11	62	0.98	0.71-1.33
Eastern European countries	452	81	0.85	0.67-1.09	38	0.73	0.52-1.03	119	0.81	0.65-1.00
Western European countries	472	71	0.72	0.55-0.93	30	0.58	0.40-0.85	101	0.64	0.51-0.81
Middle Eastern countries	307	50	0.80	0.59-1.10	21	0.73	0.46-1.15	71	0.78	0.59-1.02
Latin American countries	80	10	0.63	0.32-1.22	5	0.67	0.26-1.68	15	0.64	0.36-1.13
Asian countries	76	8	0.52	0.25-1.09	4	0.57	0.20-1.58	12	0.53	0.28-0.99
Africa countries	35	5	0.75	0.29-1.95	3	1.44	0.42-4.88	8	0.93	0.42-2.07

¹ Adjusted for age and year ²Adjusted for age, year and hospital

Table 5: Case fatality (death ≤ 28 days) in cases with a first myocardial infarction by country of birth. Women 30-74 years in Stockholm county 1985-96. Odds ratio (OR) with 95% confidence interval (CI).

Country or region of birth	n	Death out of hospital			Death within 28 days in hospital treated cases			Death within 28 days		
		No of deaths	OR ¹	95% CI	No of deaths	OR ²	95% CI	No of deaths	OR ¹	95% CI
Sweden	5571	1107			812	1		1919	1	
Foreign born	1243	250	1.04	0.89-1.21	176	1.05	0.88-1.27	431	1.05	0.92-1.20
Foreign born except born in Finland	680	132	0.99	0.81-1.22	85	0.90	0.70-1.16	222	0.95	0.80-1.13
Finland	563	118	1.09	0.88-1.35	91	1.25	0.98-1.61	209	1.19	0.99-1.43
Other Nordic countries	134	25	0.90	0.58-1.39	16	0.79	0.46-1.36	41	0.82	0.57-1.20
Baltic countries	60	12	0.99	0.52-1.87	13	1.60	0.83-3.08	25	1.34	0.79-2.25
Eastern European countries	169	33	0.97	0.66-1.42	11	0.41	0.22-0.77	44	0.68	0.48-0.97
Western European countries	132	26	0.96	0.62-1.49	22	1.31	0.81-2.13	48	1.13	0.79-1.62
Middle Eastern countries	107	20	0.91	0.56-1.50	17	1.21	0.70-2.10	37	1.07	0.71-1.60
Latin American countries	26	5	0.98	0.37-2.61	4	1.25	0.41-3.80	9	1.14	0.50-2.57
Asian countries	24	8	2.05	0.87-4.80	1	0.44	0.06-3.38	9	1.27	0.55-2.95
Africa countries	16	3	0.94	0.26-3.34	1	0.42	0.05-3.29	4	0.70	0.22-2.18

¹ Adjusted for age and year ²Adjusted for age, year and hospital

Table 6: Case fatality (death ≤28 days) in cases with a first myocardial infarction by country of birth. Women 30-74 years in Stockholm county 1985-96. Odds ratio (OR) with 95% confidence intervals (CI).

Country or region of birth	Case fatality							
	Men				Women			
	n	No of deaths	OR ¹	95% CI	n	No of deaths	OR ¹	95% CI
Sweden	11921	3810	1		3672	1139	1	
Foreign born	2217	556	0.84	0.76-0.94	707	202	0.92	0.76-1.10
Foreign born except born in								
Finland	1431	331	0.75	0.65-0.85	346	93	0.83	0.64-1.07
Finland	786	225	1.04	0.88-1.22	361	109	1.00	0.79-1.27
Other Nordic countries	233	68	0.87	0.65-1.66	93	22	0.65	0.40-1.06
Baltic countries	145	47	0.98	0.69-1.40	45	16	1.20	0.64-2.23
Eastern European countries	338	79	0.74	0.57-0.96	90	17	0.53	0.31-0.91
Western European countries	378	75	0.62	0.48-0.81	82	26	1.06	0.66-1.71
Middle Eastern countries	164	26	0.57	0.37-0.87	12	5	1.58	0.49-5.07
Latin American countries	56	10	0.69	0.35-1.38	10	3	1.26	0.31-5.02
Asian countries	53	7	0.50	0.22-1.12	6	1	0.77	0.09-6.82
Africa countries	27	4	0.57	0.20-1.68	0	0	-	-

¹ Adjusted for age, year and socio-economic status

Table 7: One year mortality in survivors of 28 days after a first myocardial infarction by country of birth. Subjects 30-74 years old in Stockholm country 1985-96. Odds ratio (OR) with 95% confidence intervals (CI).

Country or region of birth	Men				Women			
	OR ¹	95% CI	OR ²	95% CI	OR ¹	95% CI	OR ²	95% CI
Sweden	1		1		1		1	
Foreign born	1.22	1.01-1.47	1.12	0.89-1.41	0.97	0.74-1.28	0.90	0.60-1.35
Foreign born except born in Finland	1.18	0.95-1.48	1.05	0.80-1.38	0.93	0.65-1.34	0.82	0.46-1.45
Finland	1.29	0.94-1.76	1.26	0.88-1.81	1.02	0.69-1.51	0.96	0.56-1.66
Other Nordic countries	1.87	1.22-2.87	1.95	1.21-3.14	0.69	0.30-1.59	0.78	0.28-2.19
Baltic countries	1.00	0.52-1.93	0.92	0.42-2.00	1.19	0.41-3.43	1.89	0.64-5.59
Eastern European countries	1.17	0.76-1.79	0.86	0.48-1.52	1.16	0.64-2.10	0.19	0.03-1.36
Western European countries	1.05	0.67-1.64	0.82	0.48-1.43	1.30	0.61-2.76	1.21	0.42-3.44
Middle Eastern countries	0.77	0.37-1.58	0.59	0.18-1.87	0.89	0.35-2.26	3.32	0.37-30.19
Latin American countries	1.84	0.72-4.71	2.02	0.61-6.68	-	-	-	-
Asian countries	1.13	0.34-3.70	0.55	0.07-4.10	-	-	-	-
Africa countries	-	-	-	-	1.27	0.16-10.21	-	-

¹ Adjusted for age and year ² Adjusted for age, year, and socioeconomic group

STUDY III

The 1998 questionnaire was mailed to 1,083 complete pairs, or 2,166 persons. In all, 1,534 individuals responded (71%). Emigrants living in Sweden had a response rate of 75 per cent. Of the 1,083 pairs receiving the questionnaire, 652 complete twin pairs responded, 291 male and 361 female pairs, which gave a pairwise response rate of 61 per cent. There were 442 dizygotic (non-identical), 192 monozygotic (identical) and 18 pairs with unknown zygosity responding to the questionnaire. In all, 251 of the complete responding pairs were migration discordant, 103 male and 148 female pairs.

Out of all 1,534 respondents, 746 lived in Sweden and 788 in Finland, of whom 347 were returnees (Table 8). In 1998 they were between 41 and 75 years with a mean age of 52 years, and the majority of the migrants came to Sweden at the age of 18–30 years old. A majority of the migrants (78%) had stayed in Sweden for more than 10 years. The median time spent in Sweden was 6 years among those who had returned to Finland, while for those who in 1998 still lived in Sweden it was 30 years. The migrants who came early in the migration period covered by our study were often those who stayed on, while those who arrived later, more frequently returned to Finland.

The respondents in this study emigrated from Finland to Sweden mostly during the 1960s and 1970s; 75 per cent of the migrants moved to Sweden for the first time during the period 1960–79. Before 1950, the majority of those who emigrated left as children. Between 1950 and 1969, the migrants had emigrated as both adults and children, which suggest that during this period family migration was more common. After 1970, the proportion of children among the migrants decreased.

Most of the respondents—81 per cent—were Finnish-speaking, while 16 per cent were Swedish-speaking. A small part stated that they learned both Finnish and Swedish as children. A majority of the respondents, two-thirds, were born in the south and south-western parts of Finland.

The emigrants of the migration discordant pairs were somewhat older in 1998 compared to the emigrants of pairs where both migrated to Sweden or where only one of the pair responded to the questionnaire, and they also emigrated later in life and in later years and spent a somewhat shorter time in Sweden.

When comparing self-reported CHD with clinical data from 76 male twin pairs we found a good correspondence with clinical data, with a sensitivity of 88%, a specificity of 97% and a positive predictive value of 79%. We found a similar sensitivity and positive predictive value in emigrants and non-migrants.

Table 8: Characteristics of the subjects by migration status (%)

	Migration-discordant pairs n = 251	All subjects			All subjects n = 1534
		Never migrants*	Emigrants*	Returnees	
		n = 441	n = 746	n = 347	
	%	%	%	%	%
Sex					
Men	41	44	44	54	46
Women	59	56	56	46	54
Age					
41–49 years	30	41	42	54	44
50–59 years	45	39	38	34	37
>59 years	25	20	218	12	19
Mother tongue					
Finnish	81	84	77	88	81
Swedish	17	14	20	10	16
Both	2	2	3	2	2
Age at emigration					
<18 years	6	—	25	12	21
18–30 years	77	—	65	76	69
>30 years	17	—	10	12	10
Emigration period					
<1946	1	—	4	4	4
1946–1959	12	—	15	5	12
1960–1975	63	—	66	58	64
>1975	24	—	15	33	20
Time spent in Sweden					
<10 years	1	—	1	65	21
10–19 years	11	—	7	27	13
20–29 years	46	—	42	6	31
≥30 years	42	—	50	2	35

Note: * Including the migration-discordant pairs.

Analyses of the migration discordant pairs showed rather small differences in work-related and social welfare components (Table 9 and 10). Most differences were of the order of 10 per cent or less. Compared to their co-twins living in Finland, emigrants of migration-discordant pairs more often tended to have an education of at least gymnasium level, while they were more often manual workers, especially the women. Perhaps related to this, they tended more often to report being overqualified for their job. When analysing men and women together, four work-related welfare components showed statistically significant differences: education (diff. 7.4%; 95% CI 1.4 to 13.4), employment in 1998 (diff. 9.1%; 95% CI 1.7 to 16.5), being a manual worker (diff. 14.7%, 95% CI 6.4 to 23.0) and perceived overqualification (diff. 10.9%; 95% CI 2.0 to 19.8). Concerning social relations, female emigrants were more often divorced than their co-twin sisters living in Finland and they more often felt close to their relatives. In addition, they tended less often to report a lack of attachment in social relations.

Table 9: Intra-pair differences with 95% CI in welfare among male migration-discordant pairs

Welfare indicator	Number of pairs with information	Emigrants %	Never migrants %	Pairwise difference: Emigrants vs. never migrants % & 95% CI	
Gymnasium or higher education	102	17.6	10.8	6.9	(-2.3 to 16.1)
Working-class	89	71.9	65.2	6.7	(-5.1 to 18.6)
Employment 1998	96	62.5	50.0	12.5	(-0.9 to 25.9)
Ever unemployed	96	37.5	45.8	-8.3	(-23.7 to 7.0)
Perceived over-qualification for one's work	85	21.2	10.6	10.6	(-1.4 to 22.6)
Married/cohabitating	101	68.3	77.2	-8.9	(-21.5 to 3.8)
Ever divorced	96	29.2	24.0	5.2	(-7.9 to 18.3)
Social network*	102	83.3	87.3	-3.9	(-13.5 to 5.6)
Lack of attachment**	100	48.0	42.0	6.0	(-8.8 to 20.8)
Feeling lonely	87	19.5	16.1	3.4	(-9.8 to 16.7)
Feeling close to work and workmates	56	75.0	71.4	3.6	(-13.0 to 20.2)
Feeling close to one's relatives	100	74.0	79.0	-5.0	(-16.5 to 6.5)

Note: *Scale measuring availability of different kinds of social relationship; **Scale measuring availability of close social relationships.

Table 10: Intra-pair differences with 95% CI in welfare among female migration-discordant pairs

Welfare indicator	Number of pairs with information	Emigrants %	Never migrants %	Pairwise difference: Emigrants vs. never migrants % & 95% CI	
Gymnasium or higher education	142	26.8	19.0	7.7	(-0.5 to 16.0)
Working-class	115	63.5	42.6	20.9	(9.1 to 32.7)
Employment 1998	124	74.2	67.7	6.5	(-2.0 to 14.9)
Ever unemployed	124	29.8	29.0	0.8	(-10.6 to 12.2)
Perceived over-qualification for one's work	89	30.3	19.1	11.2	(-2.5 to 25.0)
Married/cohabitating	143	74.1	70.6	3.5	(-6.9 to 14.0)
Ever divorced	131	37.4	25.2	12.2	(0.9 to 23.6)
Social network*	139	85.6	83.4	2.2	(-7.1 to 11.4)
Lack of attachment**	136	22.8	31.6	-8.8	(-19.6 to 2.0)
Feeling lonely	120	20.8	18.3	2.5	(-8.2 to 13.3)
Feeling close to work and workmates	98	77.6	74.5	3.1	(-11.1 to 17.2)
Feeling close to one's relatives	143	88.1	78.3	9.8	(0.8 to 18.8)

Note: *Scale measuring availability of different kinds of social relationship; **Scale measuring availability of close social relationships.

Among men, a corresponding pattern was not found. Male emigrants more often had a job in 1998 than their co-twin brother in Finland and they also reported less unemployment over the life course. Analysing all respondents, the difference in having experienced a divorce was found statistically significant (diff. 9.3%; 95% CI 0.8 to 17.7.)

We compared emigrants and returnees to never migrants, including also incomplete pairs and pairs where both twins migrated to Sweden, thus using data for all subjects responding to the questionnaire. Generally, comparisons of emigrants and never migrants based on all subjects responding to the questionnaire generated results similar to analyses of migration discordant pairs (Table 11 and 12). Despite a small educational difference among men, the emigrants more often tended to be manual workers. Male emigrants were also more often divorced and more often reported a feeling of loneliness, but showed no difference in attachment to other persons. Female emigrants more often had extensive social networks and less often reported a feeling of loneliness.

Table 11: Prevalence of welfare indicators 1998 among male emigrants residing in Sweden and never migrants and returnees residing in Finland. Age-adjusted differences with 95% confidence intervals comparing emigrants and returnees respectively with never migrants

Welfare indicator	Emigrants %	Never migrants %	Returnees %	Age-adjusted difference: Emigrants vs. never migrants		Age-adjusted difference: returnees vs. never migrants	
	n=326	n=195	n=188				
Gymnasium or higher education	15.5	12.0	12.8	3.8	(-2.4 to 10.1)	0.1	(-5.6 to 8.2)
Working-class	72.8	59.7	60.9	12.1	(3.2 to 21.1)	-1.3	(-11.8 to 9.2)
Employment 1998	68.9	59.8	66.9	9.3	(1.8 to 16.8)	1.3	(-7.3 to 9.9)
Unemployment 1998	4.0	8.5	11.8	-4.0	(-8.4 to 0.4)	2.9	(-2.9 to 8.6)
Ever unemployed	37.0	39.2	62.0	-0.9	(-9.9 to 8.1)	21.2	(10.9 to 31.4)
Perceived over-qualification for one's work	24.0	16.6	17.8	8.2	(0.6 to 15.8)	0.5	(-7.5 to 8.5)
Married/cohabitating	65.5	75.0	75.0	-9.1	(-17.3 to -1.0)	1.5	(-7.1 to 10.2)
Ever divorced/separated	38.8	27.1	31.1	12.6	(4.2 to 21.1)	2.7	(-6.5 to 11.9)
Children	79.4	80.9	85.7	-2.0	(-9.3 to 5.3)	5.9	(-1.5 to 13.3)
Social network	80.5	83.6	80.5	-3.2	(-9.9 to 3.5)	-3.0	(-10.6 to 4.6)
Lack of attachment	42.7	43.0	45.7	-0.5	(-9.5 to 8.4)	2.0	(-8.2 to 12.1)
Feeling lonely	24.1	17.5	21.0	6.5	(-0.9 to 14.0)	2.1	(-6.0 to 10.2)
Feeling close to work/study place and work/study mates	73.7	71.4	61.5	2.1	(-6.7 to 10.8)	-11.4	(-22.5 to -0.3)
Feeling close to relatives	79.2	78.4	71.8	0.3	(-7.2 to 7.7)	-6.7	(-15.7 to 2.2)

Table 12: Prevalence of welfare indicators 1998 among female emigrants residing in Sweden and never migrants and returnees residing in Finland. Age-adjusted differences with 95% confidence intervals comparing emigrants and returnees respectively with never migrants

Welfare indicator	Emigrants % n=420	Never mi- grants % n=246	Returnees % n=159	Age-adjusted difference: emigrants vs. never mi- grants		Age-adjusted difference: returnees vs. never migrants	
Gymnasium or higher education	30.7	15.6	21.8	14.5	(0.8 to 20.7)	2.1	(-5.2 to 9.3)
Working-class	64.7	47.5	50.0	17.3	(9.2 to 25.4)	6.3	(-4.7 to 17.3)
Employment 1998	72.5	66.5	63.3	4.5	(-1.9 to 10.9)	-9.1	(-17.7 to -0.5)
Unemployment 1998	4.3	7.3	14.0	-3.2	(-7.1 to 0.7)	6.6	(-0.1 to 13.4)
Ever unemployed	30.3	33.3	49.3	-3.2	(-10.9 to 4.5)	15.6	(4.9 to 26.3)
Perceived overqualification for one's work	28.3	18.0	14.3	10.5	(3.0 to 17.9)	-5.0	(-13.5 to 3.4)
Married/cohabitating	66.9	70.4	68.6	-3.7	(-11.0 to 3.6)	-4.2	(-14.0 to 5.5)
Ever divorced/separated	41.4	27.5	41.9	13.7	(6.3 to 21.2)	14.3	(3.9 to 24.8)
Children	86.1	84.0	81.9	2.2	(-3.5 to 7.9)	-4.1	(12.2 to 4.0)
Social network	88.8	79.8	79.0	8.8	(3.0 to 14.8)	-1.6	(-10.2 to 7.0)
Lack of attachment	22.6	33.8	29.0	-11.0	(-18.3 to -3.8)	-5.3	(-14.9 to 4.3)
Feeling lonely	19.7	24.1	23.6	-4.5	(-11.4 to 2.4)	-2.5	(-11.6 to 6.6)
Feeling close to work/study place and work/study mates	79.2	72.3	54.4	7.3	(-0.6 to 15.2)	-22.0	(-33.5 to -10.5)
Feeling close to relatives	86.0	80.5	80.6	5.7	(-0.4 to 11.7)	0.9	(-7.2 to 9.1)

Returnees showed no substantial differences in education and socio-economic status compared to never migrants, although they had significantly more often been unemployed during their life. They also more seldom felt close to their work place and workmates. Regarding social welfare components, we found few differences compared to never migrants, but male returnees less often reported feeling close to relatives, and female returnees were more often divorced. To find out if there were any differences between those who stayed on and those who would later become returnees, we also analysed the welfare situation in 1975 of migrants (both emigrants and returnees) living in Sweden at that time. Those who returned were more often employed than those who stayed on (men. age-adjusted diff. +6.8%; women +7.6%). We found that future male returnees somewhat less often had high education and (age-adjusted diff. -7.2%) were more often married (age-adjusted diff. +5.6%). Future female returnees were more often manual workers (age-adjusted diff. +14.7%), more often had high education (age-adjusted diff. +9.1%) and were less often married (age-adjusted diff. -8.2%) than those who remained in Sweden.

The majority of the emigrants were Finnish-speakers who came to Sweden as adults. To get a more detailed picture of the welfare situation of the emigrants, we carried out separate analyses for Swedish-speakers as well as for emigrants who arrived in Sweden before the age of 18. We found larger differences than in the overall comparison, but the general picture was the same. Male Swedish-speaking emigrants seemed to be in a less advantageous social situation than Swedish-speaking never migrants. They were less often married (age-adjusted diff. -22.3%), had more often experienced a divorce (age-adjusted diff. +28.2%), had less often an extensive social network (age-adjusted diff. -10.4%) and reported more often feeling lonely (age-adjusted diff. +12.5%). Female Swedish-speaking emigrants seemed to be in a more stable social situation than never migrants. Despite the fact that they were less often married (age-adjusted diff. -7.3%) and had more often experienced a divorce (age-adjusted diff. +8.2%), they more often had a large social network (age-adjusted diff. +11.2%), less often reported a lack of attachment (age-adjusted diff. -18.2%) and also less often reported feeling lonely (age-adjusted diff. -11.9). In addition, they more often had high education (age-adjusted diff. +17.9%) and more often were manual workers (age-adjusted diff. +10.0%), and more often reported being overqualified for their position (age-adjusted diff. +12.1%). Compared to all emigrants, the male Swedish-speaking emigrants seemed to be in an even more vulnerable social situation, while the female Swedish-speaking emigrants seemed to have been more successful both on the labour market and in their social life.

Those who emigrated to Sweden at a young age seemed to be somewhat better off in their social life than never migrants. They reported a lack of attachment less often (age-adjusted diff. for men -10.5% and women -11.5%). Women also more often had a large social network (age-adjusted diff. +17.7%) and less often reported feeling lonely (age-adjusted diff. -9.7%). Compared to all emigrants, those men who had emigrated at a young age seemed to have done better both in the labour market and socially, while the women who came at a young age showed no large differences, except that they more often had a large social network and less often reported feeling lonely.

Another group of special interest was those who could be defined as having low integration in Swedish society. Both men and women with low integration were, more often than never migrants, manual workers (age-adjusted diff. men +18.7%; women

+39.9%) and had more often experienced a divorce (age-adjusted diff. men +14.6%; women +16.1%). They did not, more often than never migrants, perceive themselves as over-qualified for their job. Male emigrants with low integration are the only immigrant group in our study that, less often than never migrants, had high education (age-adjusted diff.). They were also less often married (age-adjusted diff. -15.4%) Compared to all emigrants, those with low integration were in a less advantageous position both on the labour market and socially.

The emigrants evaluated the influence of their emigration on their work and income situation more negatively than the influence on their social life, with over 30 per cent stating that their work and income situation had become worse (Table 13). The same opinion regarding family and friends was expressed by about 7 per cent. The same tendency was found in returnee women while male returnees made more similar evaluations of their work and income situation and their social situation.

Table 13. Respondents' assessment of the effect of the migration to Sweden (per cent)

	Better	Neither better nor worse	Worse	Total
Male emigrants				
Work and income	26.6	37.2	36.2	100.0
Family and friends	32.0	61.5	6.5	100.0
Health	15.8	78.2	5.9	100.0
In general	28.0	57.9	14.1	100.0
Male returnees				
Work and income	18.9	60.0	21.1	100.0
Family and friends	22.2	66.1	11.7	100.0
Health	9.9	80.7	8.2	100.0
In general	18.7	69.6	11.7	100.0
Female emigrants				
Work and income	34.8	31.7	33.5	100.0
Family and friends	31.2	62.3	6.5	100.0
Health	13.8	81.8	4.4	100.0
In general	28.3	60.1	11.6	100.0
Female returnees				
Work and income	20.8	57.6	21.5	100.0
Family and friends	15.5	76.1	8.5	100.0
Health	5.6	85.2	9.2	100.0
In general	12.1	75.2	12.8	100.0

STUDY IV

Analyses of CHD in the migration discordant pairs (Table 14) showed a tendency towards less CHD in emigrants compared to co-twins living in Finland (OR 0.6; 95% CI 0.3-1.4) with the largest difference in monozygotic twins (OR 0.3; 95% CI 0.1 to 1.7). When analyzing AP and MI separately, the results were similar. Adjustment for socio-economic status, education, social support, being overqualified for one's work, smoking, physical activity at leisure time, diabetes, BMI>25 only changed this estimate marginally.

Analyses of all respondents, disregarding pair status and including incomplete pairs (Table 15) showed a 40% lower prevalence of CHD in emigrants compared to non-migrants living in Finland (OR 0.6; 95% CI 0.4-0.9). Returnees did not differ markedly from non-migrants with regard to prevalence of CHD (OR 0.9; 95% CI 0.3-2.8) (Table 10).

In men, the emigrants less often reported low physical activity at leisure time compared to non-migrant co-twins (age-adjusted diff. -17.4%, 95%CI -34.4- -0.4). In women, there was a tendency towards the opposite direction, but the emigrant women were less often overweight (age-adjusted diff. -13.2%, 95%CI -23.4- -3.0). They also less often had only mandatory education, but more often had working class jobs than non-migrants. In returnees, the differences in socio-economic and behavioural factors compared to non-migrants were generally small, with the exception for smoking among women, where returnees more often were smokers (diff. 9.2% 95% CI 1.5 to 18.3%).

Table 14: Intra-pair differences and odds ratios with 95% CI of CHD prevalence in 1998 in migration discordant pairs. Odds ratios with 95% confidence intervals.

	No of pairs with information	Emigrants %	Non-migrants %	Emigrants vs. non-migrants	Emigrants vs. non-migrants†
Gender					
Men	101	12.9	13.9	0.9 0.3 to 2.6	0.8 0.3 to 2.3
Women	142	9.9	13.3	0.5 0.2 to 1.5	0.6 0.2 to 1.7
Zygoty					
Monozygotic pairs	59	10.2	16.9	0.3 0.1 to 1.7	0.4 0.1 to 2.1
Dizygotic pairs	180	11.7	12.2	0.9 0.4 to 2.1	0.9 0.4 to 2.2
Migration factors					
Emigrant arrived <26 years of age	152	8.6	12.5	0.4 0.1 to 1.3	0.3 0.1 to 1.2
Finnish-speaking pairs	195	11.3	15.4	0.6 0.3 to 1.3	0.6 0.3 to 1.3
Emigrant w. low integration	99	10.1	14.1	0.7 0.2 to 2.4	0.7 0.3 to 1.6
All	243	11.1	13.6	0.7 0.3 to 1.4	0.6 0.3 to 1.4

† Analyses showed that socio-economic and behavioural risk factors had only minor influence on CHD prevalence. Due to small numbers, we choose to adjust only for smoking in the multivariate model.

TABLE 15: Prevalence of CHD in 1998 in emigrants residing in Sweden and non-migrants and returnees residing in Finland. Odds ratios with 95% confidence intervals comparing emigrants and returnees respectively with non-migrants. Odds ratios and 95% confidence intervals.

	Emigrants %	Non-migrants %	Returnees %	Emigrants vs. non-migrants		Emigrants vs. non-migrants		Returnees vs. non-migrants		Returnees vs. non-migrants	
Men	n=326 8.8	n=195 12.0	n=188 10.4	0.7 [†]	0.4 to 1.2	0.6 [§]	0.4 to 1.2	1.0 [†]	0.5 to 1.9	1.1 [§]	0.5 to 2.4
Women	n=420 7.9	n=246 10.9	n=159 7.7	0.7 [†]	0.4 to 1.1	0.6 [§]	0.3 to 1.0	1.0 [†]	0.5 to 2.0	1.1 [§]	0.5 to 2.4
All	n=746 8.3	n=441 11.4	n=347 9.2	0.7 [‡]	0.5 to 1.0	0.6 ^{**}	0.4 to 0.9	1.0 [‡]	0.6 to 1.6	0.9 ^{**}	0.3 to 2.8

* With correction for intra-pair dependence.

† Adjusted for age. ‡ Adjusted for sex and age. § Adjusted for age, socio-economic status, smoking, and diabetes. ** Adjusted for sex, age, socio-economic status, smoking, and diabetes.

5 DISCUSSION

MAIN RESULTS

Study I & II

The main findings of Study I show that immigrants had a higher incidence of first MI, including non-fatal as well as fatal out-of-hospital cases, than Sweden-born in Stockholm during 1977-96 after adjustment for age and socioeconomic group. This applies to subjects born in Finland, other Nordic countries, Poland, Turkey, Syria, and South Asia in both genders and for men born in Hungary and the Netherlands and women born in Iraq and Sub-Saharan Africa. Foreign-born had an elevated incidence already during the first year in Sweden and an increased incidence was still noticeable after more than 20 years in Sweden. We also found a decreasing time trend of MI incidence among men during the period 1977-96 for both foreign-born and Sweden-born. Immigrated women had a somewhat less pronounced decline in MI incidence during the same period, compared to native women.

Study II shows that during the study period immigrants to Sweden did not have an increased case fatality within 28 days after a first myocardial infarction compared to Sweden-born persons when differences in socioeconomic group were accounted for. Subjects born in Finland however had an increased case fatality during the first ten years in Sweden among men and after 20 years in Sweden among women. Mortality within one year after a first myocardial infarction among survivors of the acute phase was also fairly similar between foreign-born and Sweden-born subjects when socioeconomic differences were taken into account except for male immigrants from other Nordic countries where an increase was indicated. Our results suggest that differences in survival after a first myocardial infarction between foreign-born and Sweden-born subjects are unlikely to explain an increased CHD mortality in immigrants in Sweden.

Study III & IV

The results of the study in Study III do not indicate that migration from Finland to Sweden has substantially improved access to central welfare components for the migrants. Migration was associated with a better chance of getting a job, although a higher education among emigrants did not lead to a better socio-economic position. Furthermore, it seemed to lead to problems getting a job corresponding to their perceived level of competence. Also, migration was positively correlated to divorce. Emigrant women had relatively good social relations compared to those who never migrated. Returnees were characterised by weak connections to the labour market, otherwise they did not differ in any important respect from never migrants. Low integration into Swedish society was associated with a less advantageous welfare situation. To be Swedish-speaking and having emigrated at a young age appeared to improve emigrants' chances to access several welfare components.

Study IV suggests that migration from Finland to Sweden may be associated with a reduced prevalence of CHD compared to non-migrants, even when genetic and early childhood factors are taken into account. The possible causes of a reduced prevalence

would most likely be multifactorial and may include changes in psychosocial factors, dietary habits, physical activity and inflammation. It is well known that migration from a country with a low CHD rate to a country with a higher rate is associated with an increased disease occurrence in migrants. Our results suggest that migration from a high to a low rate country may be associated with a beneficial influence on CHD rates.

METHODOLOGICAL CONSIDERATIONS

Study I and II

Study I is a population-based case control studies and study II is based on all cases in study I. The studies are basically descriptive and we may only suggest possible explanations to our results. Study I includes is based on a large material consisting of the total population of Stockholm County during 20 years. Data on myocardial infarction for Stockholm County have been validated in earlier studies and found to be of good quality.⁴² Swedish registers of hospital discharges and deaths offers opportunities for identification of myocardial infarction cases by means of record linkage and the diagnostic information on myocardial infarction used in our study has been shown to be of good quality.⁴¹ The registers used in the studies cover basically all diagnosed cases of first myocardial infarction in the population of Stockholm County during the study period. In study II, the observed case fatality rates were in good agreement with those reported from the Swedish MONICA centres⁵⁶ and from Swedish national statistics.⁵⁷ The frequency of autopsy in fatal cases was high, suggesting reasonably good quality of data on out-of-hospital-deaths. Data on country of birth was collected from censuses as well as from population registers and was almost complete. Information on socio-economic status was sometimes missing, partly because many persons were not gainfully employed at the time of the censuses. This was most frequent among women, especially immigrated women.

A limitation of study I and II is that it concerns only an urban population and with an observation period that ended more than ten years ago. During the last decade there has been extensive immigration to Sweden from countries that are not well represented in the present study. The results may not be immediately generalized to immigrant groups not included in this study or to other areas of Sweden, e.g. rural areas. There have also been important changes in the diagnosis and treatment of myocardial infarction during recent years. Another important limitation is the lack of clinical data and cardiovascular risk factors. In this way, the study is basically descriptive and may be a point of departure for more detailed studies.

Study III and IV

Study III and IV are cross-sectional studies based on self-reported data. Many of the welfare components (education, socio-economic status, employment, unemployment, marital status, parenthood) were assessed by rather straightforward questions and deal with concrete circumstances in life, and we do not think that misclassification of these variables substantially influenced our results. In these studies the problem of differences in the interpretation of questionnaire items between persons living in different countries is reduced in the pairwise analyses where the comparison is made between persons with a similar background and thus a similar frame of reference.

The analyses include comparisons of the emigrant to his or her non-migrant co-twin. This increases the comparability with regard to conditions during childhood, both in the family of origin and in a wider context, as well as regarding genetic factors. The results are based on a data collection with a reasonable overall response rate, although somewhat lower in non-migrants than in migrants. We found in general a good correspondence between register information and questionnaire data regarding residential history, suggesting a reliable classification of migration status. Self-reported CHD showed a very good agreement with corresponding data from a clinical examination. Rose's questionnaire on angina pectoris has been criticised⁵⁸ but since we found no differences in sensitivity and positive predictive value between migrants and non-migrants, we do not believe that misclassification of CHD was related to migration status.

Studies on CHD prevalence may be influenced by differences in mortality between the groups compared. In Finnish twin pairs discordant for migration to Sweden, we found only small intra-pair differences in all cause mortality.⁵⁹ Among women an increased mortality due to cardiovascular disease in migrants compared to non-migrants in Finland was noticed but the number of deaths was small and there was essentially no difference in CHD mortality. It is, therefore unlikely that the lower prevalence of CHD observed in this study can be explained by differences in mortality

A central issue of these studies is the classification of the respondents' migration experience. Data regarding migration stems from the questionnaire. Among our respondents, we found in general a good correspondence between register information and questionnaire data regarding residential history. This suggests that the registers used to identify study subjects were reliable instruments. Nevertheless, as migration from Finland to Sweden has been relatively easy, without formal hindrances, it is likely that some migrants never have ended up in registers. It is reasonable to believe that these migrants stayed in Sweden for a short time and that they were never established in the Swedish labour market, and thereby fall outside the focus of this study.

Can the results in study III and IV be generalised to all Finnish immigrants in Sweden? Studies comparing adult twins and singletons suggest that twins do not markedly differ from singletons with regard to health and life style factors.^{60 61} Compared to the emigrants in our study, all Finnish immigrants living in Sweden are in general younger, many of them younger than 41 years old, which was the lower age limit in our study.⁶² All Finnish immigrants in Sweden in the relevant age span were older than the twin emigrants, and they emigrated earlier in life. They also had higher education, something that was most salient among men. Regarding socio-economic status, there is no substantial difference between Finnish immigrants in general and the emigrant twins in our study. Taking this into account it is reasonable to assume that our results are relevant also for Finnish immigrants in general. The fact that Finnish immigrants in general, despite better education compared to the twins, did not differ from them with regard to socio-economic status suggests that the immigrants were subjected to the same unbalance between qualification and work, on both objective and subjective levels, as the twins in our study.

POSSIBLE CAUSES OF AN INCREASED INCIDENCE OF MYOCARDIAL INFARCTION IN IMMIGRANTS TO SWEDEN

Differences in exposure to known risk factors for CHD most likely contribute to differences in CHD between foreign-born and Sweden-born. Study I and II do not include data on life style factors but we know from other studies that a higher prevalence of known risk factors, including smoking, diabetes, over-weight, high blood pressure, dyslipidemi, and low physical activity, has been found in immigrants.^{63 64 65 66 67} Finland-born men in Sweden have been found to be more exposed to life style related cardiovascular risk factors including high blood pressure, diabetes, smoking, over-weight, dyslipidemia and low physical activity as well as low socioeconomic status, low education and low social support.^{65 67 68 69} For other than Finland-born immigrants a more extensive exposure to known risk factors have been reported, with the exception of hypertension where a similar prevalence as in Sweden-born has been found.^{65 66}

In Study I we show that differences in socioeconomic group are not a major reason for the elevated MI incidence at least not among men, despite the fact that socio-economic status is shown to be related to MI and there are known differences in socio-economic status between Sweden-born and foreign-born.⁷⁰ This is basically consistent with studies comparing immigrants to the native population in Great Britain as well as in the Netherlands.^{70 71} It is possible that socio-economic status represents different contexts for immigrants and native Swedes. For example, it may be more difficult to get an occupation corresponding to the level of education, some thing that was found in study III for female immigrants from Finland to Sweden.

There is increasing evidence that psychosocial factors may influence the risk of developing CHD.⁷² In the Interheart study¹⁰ stress, depression and locus of control were found to be worldwide contributors to MI risk, while other studies point to social network and social capital as circumstances of importance.^{73 74} The migration itself may constitute a stressful life event that is related to MI incidence. The elevated incidence during the first year found in study I may partly be due to this.

Integration, broadly defined as access to welfare resources such as socio-economic status, education, employment and social support, might in turn influence CHD risk. Study III deals with this important aspect of the integration of immigrants into the Swedish society. In addition, integration may have a social and a subjective aspect where the individual's social interaction with and feeling of belonging to the society are of importance. In study IV, lack of integration to the Swedish society, defined as being positioned in a social context with large interaction with one's own ethnic group was not strongly associated with CHD prevalence. Time spent in Sweden may mean experiences of different levels of integration and access to welfare resources for different groups. In addition, integration has a subjective aspect based on the individuals' own feeling of belonging to the country in question.

Ethnical and racial discrimination have been suggested to have an impact on the risk for CHD.^{75 76} Men born in Iran and Sub-Saharan African countries living in Sweden have been found to report more experience of discrimination than other groups of immigrant men.⁷⁷ Study I does not include data on factual or experienced discrimination, but in our study, these groups were not found to have an increased incidence of MI compared to Sweden-born. In study III, emigrants generally had better education than never mi-

grants. If education is seen as an investment, the pay off in socio-economic status appeared to be better for never migrants than for emigrants. Emigrants more often experienced a mismatch between qualifications and working position. Migration often means starting a new career with a new employer, thereby losing rank and other inside advantages, which old employees benefit from. Another reason for this mismatch could be that certain education levels are evaluated differently in Sweden than in Finland, or that deficiencies in language skills are seen as obstacles for promotion to more qualified work but it may also imply discrimination of non-Swedes.

Several studies have shown that the risk of CHD among immigrants is related to the incidence in the country of origin, although eventually the disease pattern becomes more similar to that of the country of immigration.^{10 11 11} In study III a decreased risk for CHD was observed in Finnish immigrants after a long period of time in Sweden. The background incidence of MI in the country of origin appears to be a major explanation of the elevated incidence in the immigrants, even if lower over-all mortality among immigrants compared to the general population in the country of birth suggests there may be a selection of healthy persons into the migrant group.⁶⁹ Thus, according to recent mortality statistics from WHO most countries from which immigrant groups with an elevated incidence in study I came have a higher rate of CHD mortality than Sweden. This is also consistent with the observation that the increased incidence appears to be present already at arrival in Sweden. Interestingly, the fact that this increase at least to some extent remains after more than 20 years in Sweden suggests that the factors responsible may not be substantially modified by living in Sweden for several years.

Also, there have been suggestions of genetic factors playing a role for differences in CHD risk between different ethnic groups, including migrants.^{78 79} This may be a factor of relevance in Sweden as well, possibly contributing to the higher incidence observed in our study among persons born in e.g. South Asia and Finland.

TIME TRENDS OF MYOCARDIAL INFARCTION

A long term trend of decreased MI incidence has been observed in Sweden as well as in many other industrialised countries,^{27 28 27 28 29 30 31 41 80} while the trend in Eastern Europe and several non-European countries has been less positive or even shown an increase. Our study showed similar time trends in MI incidence for foreign-born and Sweden-born while an earlier study reported that many immigrant groups did not have a declining trend CHD during the 1990s. The previously studied outcome was first admission to hospital due to CHD in persons aged 35-74 comparing the period 1991-93 with 1997-99. In addition, men born in Finland and in the OECD countries and women born in Africa were found to have a decreasing trend while an increasing trend was found in women born in Southern Europe, Turkey and Iran. The divergent result was probably not due to differences in measurement of disease occurrence but may be due to different time periods covered by the two studies. Our study covered a period of 20 years, thereby offering a more stable estimate of the long-term trend.

SURVIVAL AFTER MYOCARDIAL INFARCTION

The effects of established risk factors for CHD on case fatality after myocardial infarction are not entirely clear. While low physical activity, large intake of alcohol and co-

morbidity, especially diabetes, has been found to increase the case fatality and moderate alcohol consumption has been found to decrease case fatality, findings regarding smoking, serum total cholesterol and systolic blood pressure as factors contributing to case fatality have not been consistent.^{81 82 83 84 84}

The increased case-fatality seen in men from Finland in study II seemed to be present primarily during the first ten years in Sweden and was otherwise largely due to differences in socioeconomic status. In the MONICA study the case fatality within 28 days from disease onset was higher in Finland (39-48 % at different centres) than in Sweden (27 and 42 % in Northern Sweden and Gothenburg respectively),⁵⁶ suggesting that the difference observed in our study may also mirror differences in case fatality between the countries in general. In the Finnish twin pairs discordant for migration to Sweden (study III and IV) the twin living in Sweden resembled the co-twin living in Finland to a large extent regarding cardiovascular risk factors even after several years in Sweden indicating an influence from circumstances in the country of origin. One might speculate that the migration itself as a stressful life event may be a factor influencing CHD risk and could perhaps also affect case fatality in particular during the early stages of immigration. An increased early mortality in Finland-born women after more than 20 years in Sweden appears to be more difficult to explain by these factors. The increased one-year mortality in foreign-born men after surviving the acute phase of the disease was in general essentially explained by differences in socioeconomic group. This was not the case for men born in the Nordic countries and could suggest that these subjects need more attention after discharge from hospital and in the rehabilitation after the myocardial infarction. It is possible that changes in life style after the infarction need to be better stressed or that factors related to work needs to be better taken into account. A lower case fatality in immigrants might reflect a difference in disease severity. It is possible that the myocardial infarctions experienced by the immigrants were less extensive and that their atherosclerosis in general was less aggressive. This could be associated with a better survival and also e.g. with a reduced need for coronary interventions by coronary artery bypass surgery or percutaneous coronary intervention (PCI). In addition, survival after MI may also be affected by re-migration, although in study IV of Finland-born immigrants in Sweden, returning back to Finland did not seem to be related to health problems.

COMPARISONS BETWEEN FINNISH EMIGRANTS AND NON-MIGRANTS

Study III indicates that emigration from Finland to Sweden did not improve access to welfare component while study IV suggested a reduced CHD prevalence among emigrants. Not all changes since migration regarding CHD as well as risk factors for CHD may be considered as an effect of the migration. Studies comparing Indian emigrants with non-migrants living in India have found increased levels of risk factors for CHD in emigrants living in UK,^{85 86 87 88} although female immigrants from India living in Australia were found to have a more favourable disease risk profile than those in India.⁸⁹ These differences were interpreted as an effect of changed life style due to migration. In general, the prevalence of risk factors for CHD has been found to be higher in Finland than in Sweden, except for smoking among women, which is more common in Sweden. It has also been reported that Finnish immigrants in Sweden have a higher prevalence of risk factors for CHD^{64 65 66} than native Swedes. In the research program based

on the FTCS several factors of possible relevance for differences in CHD prevalence have been evaluated. In identical male twins it was found that emigrants to Sweden had higher diastolic blood pressure and higher body fat percentage, factors contributing to higher CHD risk, while emigration to Sweden did not appear to be associated with differences in manifest CHD.⁴⁷ They had better vessel elasticity, measured by endothelial function while attenuated endothelial function was found in non-migrants in addition with a higher prevalence of Chlamydia pneumoniae seropositivity^{47 48 49} suggesting higher risk for CHD in non-migrants. Chronic Chlamydia pneumoniae infection leading to an inflammatory reaction in the arterial wall has been thought to play a role in triggering CHD events.^{90 91 92} A lower exposure to Chlamydia pneumoniae infection in Sweden than in Finland may have contributed to a reduced CHD prevalence in the migrants. Another factor that has emerged as possibly contributing to a reduced CHD prevalence in the migrants includes changes in dietary habits. Migration from Finland to Sweden was associated with substantial changes in the dietary pattern, reflecting population differences in eating habits between the two countries.⁹³ Emigrants consumed more fresh fruit, less potato, less sweet coffee bread, and more often cut out visible fat from meat. On the other hand, the non-migrants added less salt to dishes and ate more dark bread and berries. These differences are most likely of importance for the risk of developing CHD, but the net effect may be difficult to determine. Major traditional risk factors for CHD such as tobacco smoking,⁹⁴ dyslipidemia, hypertension,^{47 48} diabetes and low social status have not been found to be substantially improved in migrants compared to non-migrant co-twins.

WHO BECOME A MIGRANT AND WHO RETURNS?

It may take special personal qualities to become a migrant and when favourable characteristics are found in immigrants, the question of a possible selection of healthier, stronger or better equipped persons into the migrant group presents itself. Selection may also be on larger social units as the family or the local community, that is, migration may occur by families or be concentrated in certain communities.⁹⁵

In study III and IV we had the possibility to study the selection into the group who emigrate and also, later in the process, the selection into the group who return to the country of birth. The signs of a better social life among emigrant women, compared to never migrants found in study III, may be seen as partly a result of migration or as an indicator of a social capacity that in turn leads to migration. In an ethnographic study of emigration from the Finnish village of Närpes, it was found that those who became emigrants showed no difference in social integration in Närpes compared to those who remained in Finland.⁴ If this is the case for the respondents in our study, it would support the assumption that the migration has affected social life, rather than the other way around. To be unmarried may be a social characteristic associated with an increased tendency to become a migrant. It was found that married men were more likely to get a job in Finland than unmarried men, which in turn increased their chance of remaining in Finland.⁴ The emigrants in our study were less often married in 1975 as well as in 1998.

In the case of migration from Finland to Sweden, the selection may be related to mother tongue. In Finland, people of Swedish mother tongue, a 6 per cent minority of the Finnish population but a larger fraction of the emigrants, have a lower risk of death and

CHD than the majority population, even taking into account conventional risk factors.⁹⁶ This could in part contribute to a lower prevalence of CHD in emigrants compared to non-migrants in general, but cannot explain differences observed in intra-pair comparisons of migration discordant pairs.

Differences in education or socio-economic status may be the result of a selection into the migrant group of persons with certain educational or socio-economic background. In the intra-pair comparisons in study III, this constitutes less of a problem because such factors as age and gender, as well as geographic, ethnic, linguistic and socio-economic background and other childhood family factors are the same for both twins in each pair. Differences found in this kind of analysis are differences that exist in spite of the fact that the background factors are similar. Another study based on the FTCS showed that emigrants are self-selected by health behavioural and personality factors.⁹⁷ Life dissatisfaction, higher alcohol use and smoking before emigration predicted future migration. In men additionally, unemployment, neuroticism and extroversion increased the probability to migrate. It was also reported retrospectively that prior to migration the migrated twin had been less satisfied with his/her educational institution or job and was generally less satisfied with life, used more alcohol (men) and smoked more (women) than the co-twin who remained in Finland.

A healthy migrant selection is consistent with earlier reported lower all-cause mortality among immigrants in Sweden compared to the general population in the country of birth;⁶⁹ while on the other hand, it is not the only possible explanation. In study I, where immigrants from all over the world are included, a selection of healthy persons into the emigrant group may have contributed to the lower incidence of MI in some groups and also to the lower case fatality seen particularly among men. The selection processes for becoming migrant and re-migrant probably differs between countries depending on geographical distance, and the situation in the country in question. Post-war migration from Finland and other Nordic countries as well as from Italy and former Yugoslavia during the 1960s and 1970s to Sweden has mainly concerned labour migration while other immigrant groups often include refugees, with less possibility to return. In the case of labour migration one might expect a selection of healthy workers into the emigrant group, while on the other hand being a manual worker could mean higher CHD risk. The selection process among refugees may favour somewhat different characteristics than labour migration. When it comes to migration due to family reunion, the selection may be operating through the individual who initiated the migration and not on the accompanying family members. One might consider a gender difference in this kind of migration although family reunion migration to Sweden consists of almost 60% women⁹⁸ suggesting only small gender differences in the selection process. There are strong reasons to believe that there is not one selection process but many dependent on the emigration context.

If there is a healthy migrant selection there may also be an unhealthy migrant selection in the case of re-migration. When you are old and unhealthy, you may have a tendency to return to your country of birth, something that has been suggested regarding Latino immigrants in the US.⁹⁹ The inclusion of returnees in study III adds important information about the selection process out of the emigrant group. Their lower educational level compared to that of the emigrants who stayed on may produce or reflect a weaker position in the labour market, with more unemployment during their life in Sweden,

which in turn may have been the reason they returned. We found no evidence of this in 1975 when those who later became returnees were more often employed, but a hardening situation on the labour market during the 1980s and 1990s may have changed the situation. Most of the returnees went back during the 1980s and 1990s. Also, regarding social support, there are reasons to believe that a selection out of the emigrant group may have influenced the results. The comparison between female returnees and never migrants shows in general smaller differences in social support than the comparison between emigrants and never migrants. This may suggest that emigrants with problems in establishing personal relationships more often returned to Finland. The women who stayed on may more often be those who were more successful in the social arena. Returnees did not differ substantially from non-migrants regarding CHD prevalence. This could be due to a short duration of stay in Sweden or it could be due to a selection of unhealthy persons into the returnee group, although the majority of returnees went back to Finland before the age of 35. We found no difference between healthy returnees and returnees with CHD regarding duration of stay in Sweden or age at re-migration and there was most likely no bias due to re-migration of persons with cardiovascular health problems.

6 CONCLUSIONS

- Immigrants had a higher incidence of first MI including non-fatal as well as fatal cases compared to Sweden-born in Stockholm during the period 1977-96 after adjustment for age and socioeconomic group.
- Immigrant men had a decreasing time trend of MI incidence during the period 1977-96 of the same magnitude as Sweden-born. Immigrated women had a somewhat less pronounced decline in MI incidence during the same period, compared to native women.
- Immigrants did not have an increased case fatality within 28 days after a first myocardial infarction compared to Sweden-born persons when differences in socioeconomic group were accounted for. Subjects born in Finland however had an increased case fatality during the first ten years in Sweden among men and after 20 years in Sweden among women.
- Differences in CHD mortality between foreign-born and Sweden-born appears to be due to higher MI incidence more than to a lower survival after MI.
- Migration from Finland to Sweden did not substantially improve access to central welfare components for the migrants.
- Migration from Finland to Sweden was associated with a reduced prevalence of CHD compared to non-migrants, when genetic and early childhood factors were taken into account. In addition, survival after MI may also be affected by re-migration, although in study IV of Finland-born immigrants in Sweden, returning back to Finland did not seem to be related to health problems.

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