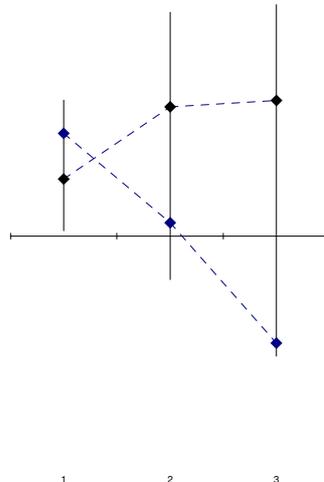


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CARDIOVASCULAR DISEASES IN IMMIGRANTS IN SWEDEN

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**Karolinska
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ABSTRACT

Aims The general aim with this project was to elucidate coronary heart disease (CHD) morbidity and mortality among immigrants in Sweden, by investigating the morbidity from CHD, comparing all-cause and CHD mortality between immigrants in Sweden and natives in the country of birth, analyzing the trend of CHD, and estimating the prevalence of CHD risk factors.

Methods The *first study* was designed as a follow-up study of the incidence of CHD among twelve immigrant groups. The *second study* was designed as a follow-up study on mortality from CHD among eight immigrant groups compared to their country of birth. The *third study* was designed as a follow-up study on the trend of CHD among eleven immigrant groups. In these three studies the material was based on the whole Swedish population. The *fourth study* was designed as a cross-sectional interview study of unhealthy behaviors and risk factors of CHD among eight immigrant groups in Sweden.

Results In the *first study*, the age-adjusted risk of CHD was higher in most foreign-born groups than in Swedes, e.g. in nine out of twelve male groups, and in seven out of twelve female groups. After adjustment for level of education and employment status, the risks were still high, but on a lower level. In the *second study*, the all-cause mortality risk was lower among seven out of eight male immigrant groups and among six out of eight female immigrant groups than in their country of birth. The CHD mortality risk was lower in four out of eight male immigrant groups, and among two out of eight female immigrant groups, than in their country of birth. In the *third study*, the morbidity trend of CHD decreased slightly among men from Sweden, Finland, and the OECD during the 1990s. The contrary was observed in women from Southern Europe, Turkey, and Iran, in whom CHD morbidity increased. In the remaining immigrant groups the morbidity was unchanged. In the *fourth study*, the age-adjusted risk of smoking, physical inactivity, and obesity was higher among immigrants than Swedes. In all of the male immigrant groups, and in three of the female ones, the frequency of smoking behavior was increased. Further, there was an increased frequency of obesity in three female and two male groups and of physical inactivity in six male and female immigrant groups. In a second model, also adjusting for education, unemployment, and social network, the increased frequency of smoking, obesity, and physical inactivity remained in almost all groups.

Conclusions Immigrants run an excess risk of CHD compared to Swedish-born persons. Despite this increased risk of CHD, the all-cause mortality risk was generally lower among immigrants than in their country of birth. The change of CHD mortality risk was more complex. It seemed as if low and high CHD risk countries could be defined, and that with migration, people tend to adopt the risk level of the new country. There was a declining trend of CHD only among a few male groups, while the decline ceased among the majority of groups, and the risk even increased in some of the female groups. This might be a sign of a breaking trend in these diseases. The increased risk of CHD among the majority of immigrant groups in Sweden might be explained by high prevalence of unhealthy behaviors and risk factors for CHD, such as smoking, obesity, and diabetes, which might be a lifestyle remnant from their country of birth or brought about by stressful migration and acculturation into a new social and cultural environment.

LIST OF PUBLICATIONS

1. Gadd, M., et al., Morbidity in cardiovascular diseases in immigrants in Sweden. *J Intern Med*, 2003. **254**(3): pp. 236–43.
2. Gadd, M., et al., *The trend of cardiovascular disease in immigrants in Sweden*. *Eur J Epidemiol*, 2005. **20**(9): pp. 755–60.
3. Gadd, M., J. Sundquist, S.E. Johansson, and P. Wandell, *Do immigrants have an increased prevalence of unhealthy behaviours and risk factors for coronary heart disease?* *Eur J Cardiovasc Prev Rehabil*, 2005. **12**(6): pp. 535–41.
4. Gadd, M., S.-E. Johansson, J. Sundquist, and P. Wändell, *Cardiovascular disease in immigrants - a comparison between mortality rates in the country of origin and in Sweden*. *BMC Public Health*, 2006 (**6**:102).

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Table 1 A summary of the main features of methods used in the four studies in this project

Study	Title	Study sample	Study design	Outcome	Statistical Methods	Individual data on time	Measures	Model	Groups of immigrants
Study I JIM 2003	Morbidity in cardiovascular diseases in immigrants in Sweden	Total Swedish population 35-64 years	Follow-up on CVD/CHD morbidity	CVD/CHD morbidity	Cox PH Regression Model	Yes	IR HR	Model I & II	12 (1–12)
Study II BMC Public Health 2006	Are there differences in mortality between immigrants and the population in the country of birth?	Total populations 45-74 years	Follow-up on total and CHD mortality	All-cause and CHD mortality	Poisson regression	Yes, but summarizing the individual data to a compressed data set	IR IDR	Model I	8 (1, 3, 4, 13–17)
Study III Eur J of Epidemiology 2005	The trend of CVD in immigrants in Sweden	Total Swedish population 45-74 years	Follow-up morbidity trends of CVD/CHD	CVD/CHD morbidity	Poisson regression	Yes, but summarizing the individual data to a compressed data set	IR IDR	Model I & II	11 (1–5, 7–13)
Study IV Eur J of Cardiovascular Prevention and Rehab 2005	Do immigrants have increased prevalence of unhealthy behaviors and risk factors for CHD?	All interviews performed	Cross-sectional on risk factors	smoking, obesity, physical-activity, hypertension, diabetes	Log-binomial	Cross-sectional, no time but prevalences	Prevalence PR	Model I & II	8 (1–5, 8, 9, 17)

Measures: IR-incidence ratios, HR-hazard ratios, IDR-incidence density ratios, PR-prevalence ratios. **Models:** Model I: Adjusting for age only. Model II: Adjusting for age, level of education, and occupational status. **Groups of immigrants:** 1 Finland, 2 OECD, 3 Southern Europe, 4 Poland, 5 Eastern Europe, 6 Bosnia, 7 Latin America, 8 Turkey, 9 Iran, 10 Iraq, 11 Asia, 12 Africa, 13 Norway, 14 Denmark, 15 Germany, 16 Hungary, 17 Chile.

LIST OF ABBREVIATIONS

CHD	Coronary Heart Disease
CI	Confidence Interval
CVD	Cardiovascular Disease
HHP	Honolulu Heart Program
HR	Hazard ratio
ICD	International Classification of Diseases
MigMed	Migration Medicine database
RR	Relative risk
SALLS	Swedish Annual Level of Living Survey
SD	Standard deviation
SEF	Socio-economic factors
SES	Socio-economic status
WHO	World Health Organization
WHOSIS	World Health Organization Statistical Information System

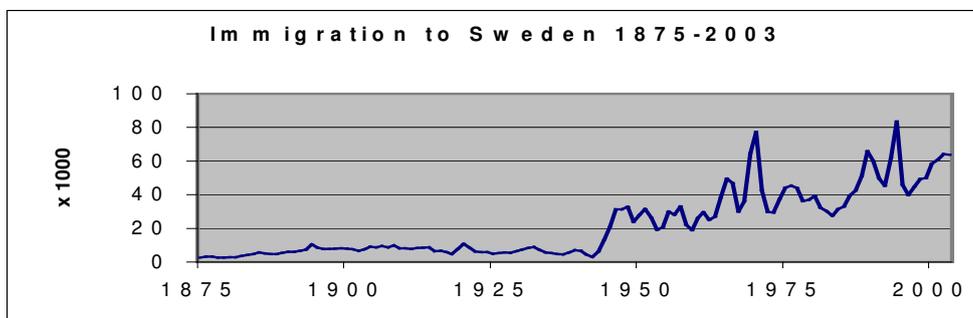
1 INTRODUCTION

The leading cause of death in the Western world is death from cardiovascular diseases (CVD). The risk of developing these diseases differs a great deal between countries; high and low risk countries may be defined. At the same time there is a rising flow of international migration. These circumstances have together made the topic of cardiovascular health among immigrants increasingly important, and led us to choose to design this project.

1.1 MIGRATION

International migration increased considerably in the last decades of the 20th century because of people escaping war, poverty, and political, economic, and religious repression. In Sweden too, immigration has increased, and on 31 December 2005 12.4% of the total population were first-generation immigrants. Swedish society has become multicultural and multiethnic, and will probably remain so in the future because of increasing migration in a boundless Europe [1].

Figure 1 Number of immigrants to Sweden 1875–2003 [2].



1.1.1 A historical view

Immigrants have arrived to Sweden for centuries, e.g. Hanseatic Germans in the Middle Ages, Finns who settled in the Mälardalen region around Stockholm in the 16th century, Gypsies or Roma who began arriving as early as the 16th century, Walloons who were brought over to teach Swedes the iron trade in the late 17th century, Savolax-Carelian Finns granted tax relief if they settled in primeval forest land in the 17th century—in the area now known as “Finn Territory,” Jews who were allowed to settle in four Swedish towns in the 18th century, French artists, philosophers and intellectuals in the 18th century, Italian stuccoists when the stone towns of the 19th century were being built, and Scots who, among other things, started breweries [1].

1.1.1.1 Mass emigration a threat to the nation

During the mass emigration of Swedes from the mid-19th century up until 1930, a considerable number Swedes emigrated to the US, Canada, South America, or Australia. Over a period of some 100 years, about 1.3 million Swedes emigrated to seek their fortunes, due to poverty, religious persecution, lack of faith in the future, political constraints, a thirst for adventure, “gold fever,” and the like. The First World War along with immigration curbs in the US slowed the rate of emigration, which had become a major problem in Swedish society. In conjunction with the Second World War, Sweden moved from being an emigrant country to being an immigrant country. Nearly every year since 1930, immigration has exceeded emigration [1].

1.1.1.2 War refugees and the influx of labor in the 1950s and 1960s

It was the refugees from Germany, from Sweden’s Nordic neighbors and from the Baltic States that transformed Sweden from an emigrant into an immigrant country during the Second World War. Many of these refugees returned to their native countries after the war, but a large number remained, among them most of the Balts.

In the post-war period labor immigrants from other parts of Scandinavia as well as from Italy, Greece, Yugoslavia, Turkey, and other countries dominated immigration. Sometimes, even people were brought here in organized groups, by the labor market authorities [1].

1.1.1.3 Regulated immigration in the 1970s

In the late 1960s, immigration to Sweden was regulated, and immigrants had to have a residence permits prior to entry. Those wishing to come to Sweden to work were required to have a written offer of employment, and permits were only granted where Sweden was in need of a particular type of foreign labor. Exempted from labor market checks were immigrants from the Nordic countries, who since 1951 had enjoyed the right to settle and work wherever they liked in the Nordic area without special permission of any kind, refugees, and close relatives wishing to be united or reunited with their families in Sweden [1].

1.1.1.4 The 1980s—decade of the asylum-seeker

In the mid-1980s, asylum-seekers from Iran and Iraq, Lebanon, Syria, Turkey, and Eritrea began to increase in number throughout Western Europe. **Asyl** (av [latin](#) *asy'lum*, fristad, tillflyktsort) Towards the end of the decade, people from Somalia, Kosovo, and with the collapse of communist oppression, several of the former states of East Europe began to join the queue of asylum-seekers. [1].

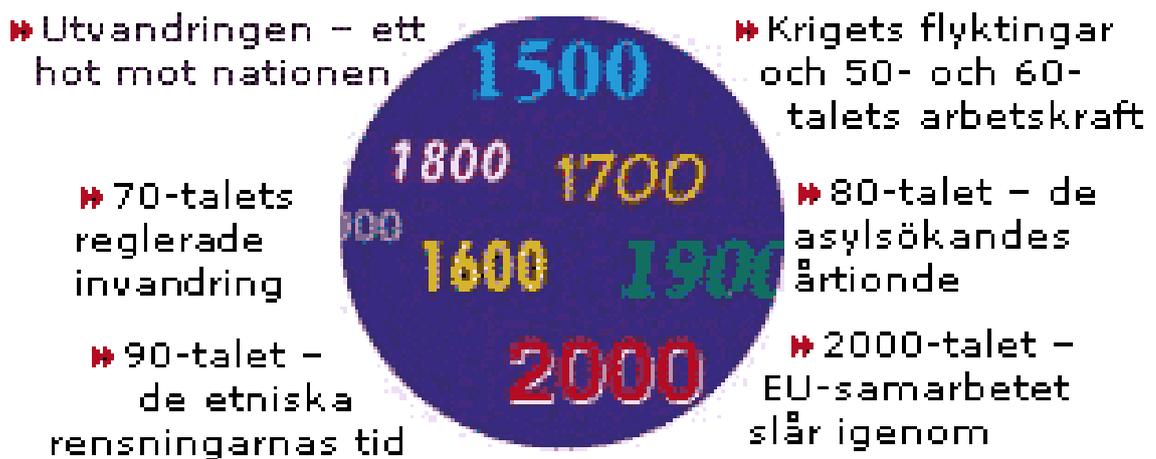
1.1.1.5 The 1990s—a time of ethnic cleansing

The 1990s brought the end of the Cold War, the shift towards democracy and the beginnings of economic development in several of the former communist dictatorships. A number of lengthy wars came to an end, e.g. in Lebanon, Eritrea, Iran–Iraq, and the number of asylum-seekers began to fall.

The 1990s also brought the collapse of the Yugoslav state with the ensuing division of the country and the descent of the region into war, terror, and ethnic cleansing. For the first time since the Second World War, huge numbers of people were in flight in the heart of Europe. In Sweden, over 100,000 ex-Yugoslavs, mostly Bosnians, found a new home.

As the new millennium approached, the flight of Kosovo Albanians started and 3,600 were evacuated to Sweden with temporary protection pending the time when their native country would become a safe haven and reconstruction could begin [1].

Figure 2 History of migration to and from Sweden [1].

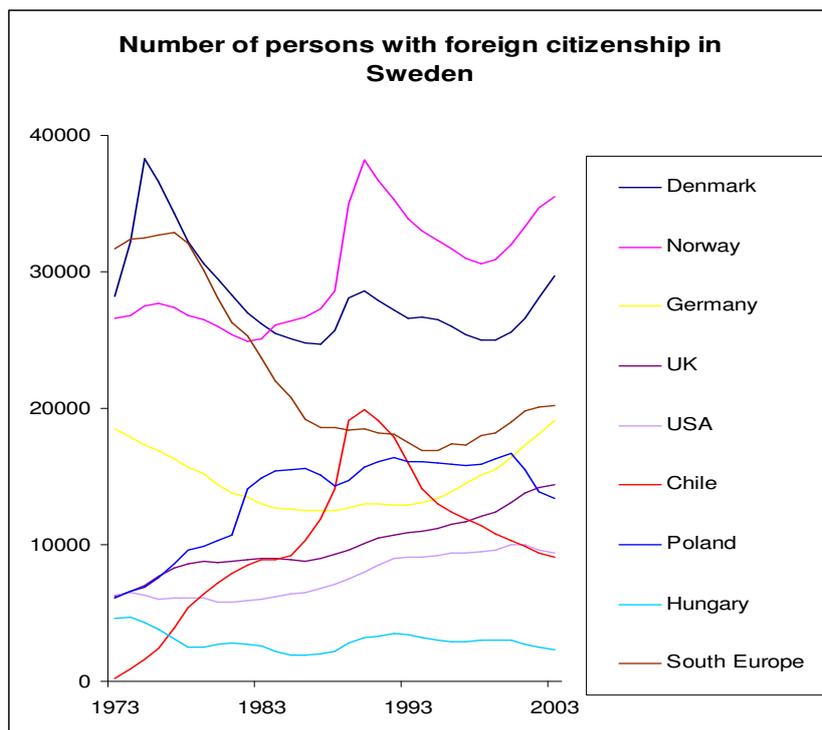


1.1.1.6 Today—during the 2000s

In 2005, 65,229 people immigrated to Sweden. Nineteen percent of the immigrants came from the Nordic countries, 34% from other parts of Europe (Serbia, Bulgaria), and 47% from countries outside Europe. A total of 165 nationalities were represented. The most frequent groups, after Nordic citizens, were persons with Polish or Iraqi citizenship. During 2005 immigration from the ten countries entering the European Union in May 2004 continued to increase. They accounted for 12% of the total amount of immigrants to Sweden that year, and 8% of the total were Polish citizens. Among the two-thirds who were non-Nordic nationals, most were granted residence permits for family reasons (54%). Much smaller proportions immigrated for work (13%), studies (9%), or for humanitarian reasons (9%). The share of refugees among

the immigrants was only 8%. Polish citizens stand out from the general pattern in that 45% were granted residence due to employment. In 2005, 17,530 persons sought asylum in Sweden. Among those applying for asylum, 33% came from Europe, 17% from Africa (Libya, Eritrea, and Somalia), 35% from Asia (Iraq, Russia), and 3% from America. The largest group of asylum seekers consisted of citizens of Serbia and Montenegro followed by Iraqi citizens [1, 2].

Figure 3 Number of persons with foreign citizenship in nine nationality groups in Sweden in 1973–2003 [2].



1.2 CARDIOVASCULAR DISEASES

Coronary heart disease (CHD) and stroke—the principal components of cardiovascular disease (CVD)—are the first and third leading causes of death in the Western world, accounting for nearly half of all deaths. About 45,000 Swedes die of CVD each year [2]. Although CVD is often thought to primarily affect men and older people, it is, alongside death by accidents, a major killer of women and people in the prime of life. More than half of all CVD deaths each year occur among women. A consideration of deaths alone understates the burden of CVD. About one-fourth of the population lives with these diseases. CHD is one of the leading cause of disability among working adults. At all ages, more women than men die of stroke. Stroke is a leading cause of serious long-term disability [3].

Arteriosclerosis is the main mechanism of CVD. Atherosclerosis affect the blood vessels in the whole body. Deposits of lipids on the inner surface of the vessel, later

covered by a fibro-muscular cap to form a fibrous plaque, leads to narrowing of the arteries [4]. The symptom depends on the localization of the plaque. The most common sites for symptoms of arteriosclerosis are from the vessels in the heart, by heart attack, in the brain by stroke and in the legs by claudication, and are caused by insufficient blood supply. In addition, instable fibrous plaque may burst and the blood starts to clot at the place of the burst, which may speed up the first appearance of symptoms

1.2.1 Risk factors

The arteriosclerotic process, the basic mechanism of CVD and CHD, begins in early in life and increases with age [4]. The arteriosclerotic process is speeded up by unhealthy behavior and risk factors such as smoking, lack of physical activity, hypertension, diabetes mellitus, hyperlipidemia, and overweight [5-10]. Other factors, e.g. socio-economic factors (unemployment and level of education), psychological stress, and male sex, also speed up the arteriosclerotic process {Winkleby, 1999 #2053; Hackam, 2003 #2098; Rosengren, 2004 #2096}.

1.2.1.1 Physical risk factors

Smokers have twice the risk of heart attack of non-smokers [11]. Nearly one-fifth of all deaths from CVD are smoking-related. Further, people who are physically inactive have higher risk of CHD than those who are active [12-14]. Also, people who are overweight have a higher risk of CVD than those with normal weight [9, 15-20] and increased risk of developing high blood cholesterol, diabetes and hypertension—another three risk factors of CVD and CHD [21-35].

1.2.1.2 Psychological risk factors

There is an association between psychological behavior and CHD [36-42]. Individuals with electrocardiogram (ECG) signs of CHD, and those showing symptoms, were more anxious, aggressive, defensive and inhibited than those free from signs or symptoms. It has been suggested that the poor prognosis associated with angina pectoris may be related to the psychological characteristics of the patients who suffer from it. Subjects dying from myocardial infarction are described as differing from survivors in psychological characteristics, including optimism, inhibition and superego strength. Further, there is an association of lowered self-esteem, high somatization, inhibition, neuroticism, differentiation, and certainty with myocardial infarction [40].

1.2.1.3 Socio-economic risk factors

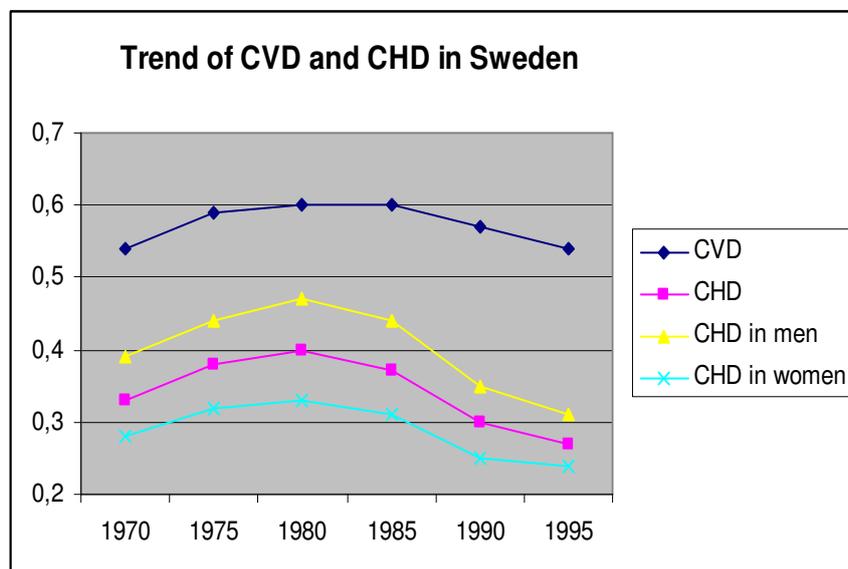
Socio-economic status (SES) is an important factor for social patterning in disease. The relationship between low SES and mortality is well documented [43-46]. Further, there is an association between SES and morbidity. Individuals with low SES have higher CHD morbidity than their SES counterparts [47-50]. There is an association

between SES, coronary risk factors and subjective well-being, e.g. smoking has been found to be inversely associated with level of education, diabetes inversely associated with education level, self-rated health with employment grade, and affect balance with employment grade [51].

1.2.2 Trend of risk factors

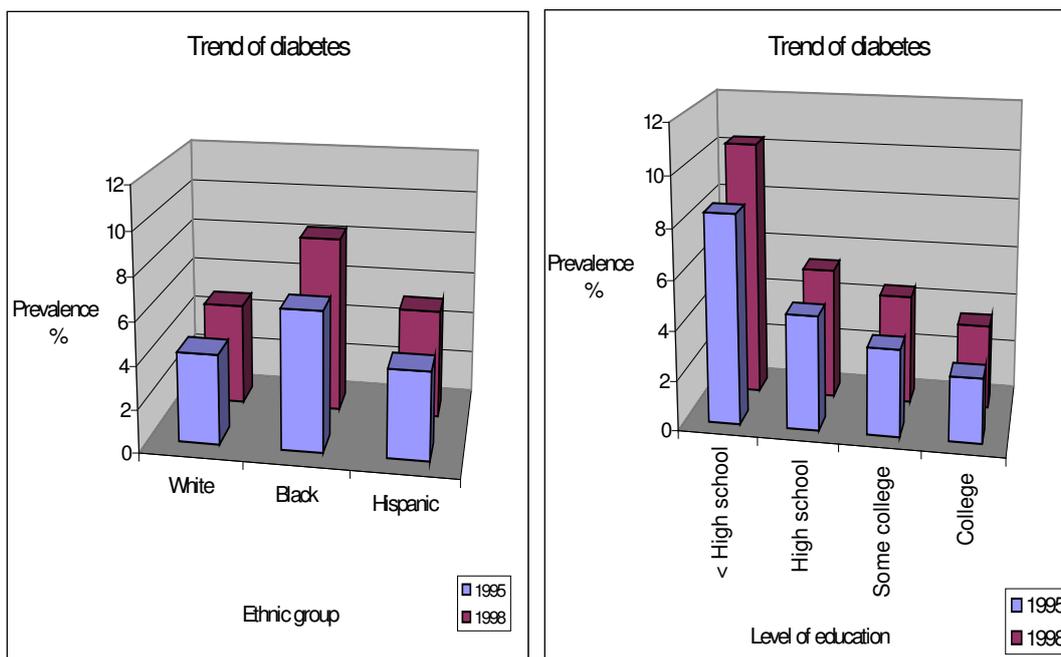
Mortality and morbidity in CVD and CHD have continuously decreased since the 1950s in the Western world [52-65].

Figure 4 Crude death rates for CVD and CHD in Sweden from 1970 to 1996 [2].



Mortality from these diseases has been decreasing fast in many countries, while simultaneously rising fast in others, as in Eastern Europe and sections of developing populations [62, 63, 64, 66-68]. Changes in morbidity and mortality are preceded by changes in the occurrence of lifestyle behaviors and risk factor distribution in the population [53, 69-77]. Yet this declining trend in mortality and risk factors has recently ceased [53, 78] and new risk factors such as obesity and type-2 diabetes have arisen [53, 69-72, 75]. These recently arising risk factors and diseases may retard earlier benefits in the morbidity and mortality trend of CVD and CHD.

Figure 5 Diabetes* trends in the United States from 1995 to 1998 according to selected characteristics in persons aged >18 years [53].



1.2.3 Prevention

Physical risk factors for CHD, such as heredity for early arteriosclerotic disease, smoking, diabetes mellitus, hypertension, hypercholesterolemia, and overweight, and psychological risk factors, such as stress, speed up the arteriosclerotic process. Treatment and prevention of these risk factors are of the utmost importance to improve public health, but require huge resources. Screening for patients with risk factors and symptoms of these diseases, followed by counteractions, e.g. information, education, and treatment, might be efficient in preventing these diseases and secondly decrease individual suffering and costs to society. Refining the screening procedure in order to find the patient before any CHD has developed ought to be the most efficient and inexpensive approach. Refining the screening procedure by discovering new risk factors for CHD, such as finding sections of the population at risk, could assist in the prevention of these diseases[53, 79-82].

1.3 MIGRATION AND HEALTH

The rising flow of international migration has made the topic of health among immigrants increasingly important worldwide. The reasons for migration may differ a great deal, as there are political refugees, labor immigrants, and socio-economic migrants. The character of their country of origin may also differ as regards geography, religion, culture, and economy. But immigrants in a new country may have in common, regardless of origin, a heavy exposure to psychological and physical stress. In general, heavily psychological and physical stress are risk factors for unhealthiness; specifically the risk of CVD and CHD may increase [42, 83-85].

The risk of developing CHD differs between countries. High- and low-risk regions or countries may be defined. In Europe, Eastern Europe is a region of high-risk of CHD while Southern Europe or the region around the Mediterranean Sea is a region of low risk, with Northern Europe in between [86]. The lower risk of CHD in Southern Europe has been associated with the “Mediterranean diet” or “French paradox,” i.e. a lower risk of CHD in these countries despite a high risk of traditional cardiovascular risk factors. Around the world, the risk of CHD is higher in the Western countries, i.e. Europe and North America, than in the rest of the world, with low rates especially in Asia. For migrants, there is generally a difference in CHD risk between the country they leave and the new country.

Lifestyle factors are often closely related to health and may either promote health or be risk factors for disease [47, 48, 50, 51, 87-97]. Lifestyle most often differs between countries, for example food culture, smoking habits, physical exercise, and alcohol consumption. Among immigrants, the lifestyle in the country of birth generally has a strong influence on the lifestyle in the new country. Through time, however, immigrants may abandon the lifestyle, along with the risk factors and morbidity of the country they have left, to assume the lifestyle, risk factors, and morbidity, of the new country [98-100]. With acculturation, e.g. the acquisition of a new culture, a previous healthy lifestyle may deteriorate [101] or a previous unhealthy lifestyle may improve.

The health of immigrants may also be affected by life in the new country, e.g. by social factors, such as how the immigrant is accepted by, and accepts, the social and cultural traditions in the new country. Earlier life experiences, such as education and social position, may have little influence on the new life. Instead, the way in which the immigrants’ education and skills are accepted is more important. In reality, immigration often leads to unemployment, poverty, loss of cultural and social affinity, as a consequence of repression and social discrimination. Unemployment, poverty, and loss of cultural and social affinity are factors closely connected to increased physical and psychological stress and secondly deteriorated health. The degree of acculturation into the social and cultural system in the new country increases with time. The second generation of immigrants are evidently further acculturated than the first-generation immigrant parents. With acculturation and integration into Swedish culture and society, the risk of repression and social discrimination diminishes. But among those who are not acculturated, the risk of repression and social discrimination may continue, leading to higher stress and poorer health than among those who are acculturated.

1.3.1 A glance at the literature

Many studies have been performed on immigrants and health but they present contradictory results. The majority of studies describe deteriorating health, but the remainder describe improved health [58, 85, 102-114].

1.3.1.1 Deteriorated health in immigrants

Deteriorated health is, for example, described in Sweden. Bosnian women have worse quality of life than native women [115]. Immigrants from Arabic-speaking countries have a high risk of low self-reported health [116]. Iranian refugees have a high risk of psychological distress [117]. Turkish immigrants in Sweden run a higher risk of long-

term psychiatric illness than Swedes [118]. Finnish immigrants, the largest immigrant group in Sweden, have poorer physical and psychological health than Swedes [119]. Every fourth refugee from Latin America has a history of torture, which can explain poorer psychological health and long-term diseases [117, 120, 121]. In 1985–89 an excess risk of suicide was seen in immigrants from Eastern Europe [122]. Immigrant women from Poland had a twice as high a risk of committing suicide as women living in Poland [122]. Immigrants from Finland and other OECD countries and refugees from Poland and Iran had higher risks of attempted suicide than Swedish-born. Women born in Latin America, Asia, and Eastern Europe had significantly higher risks of attempted suicide than Swedish-born women [123].

Some studies have shown a higher risk of CVD and CHD among immigrants than among natives in the new country. For example, a case-control study of southern Stockholm between 1974 and 1976 showed that Finnish-born men had a 70% excess risk of CHD compared to Swedish-born. After 20 years in Sweden the risk decreased but was still higher than for Swedish men [124]. In addition, immigrant women from Eastern Europe had a higher risk of CVD mortality than Swedish women [125]. Social and cultural factors might account for the increased incidence rates of CHD among immigrants [58, 126-129]. With acculturation a previously healthy lifestyle may deteriorate [101]. Studies from the UK showed that immigrants from India, Pakistan, and Bangladesh and Indians from East Africa had an excess risk of CHD independent of regional, cultural, and religious differences [130, 131]. Further studies have reported an excess risk of CHD in immigrants compared to natives [124, 125, 130, 132-134].

Other studies have shown a higher incidence of CVD/CHD risk factors among immigrants. For example, increases in CVD risk factors were observed in South-Asian immigrants in Glasgow and in male immigrants from the Pacific Atoll in New Zealand, following migration [99, 135]. Physical inactivity was more frequent among Swedish immigrants than among Swedes [12]. Other studies demonstrated that hard work; prolonged working hours, and poor chances of advancement in their job career affected immigrant health in a negative way [119].

1.3.1.2 *Improved health among immigrants effect—“The healthy migrant effect”*

Immigrants from Southern Europe and other countries from the Organization for Economic Co-operation and Development (OECD) have lower risks of CVD than the native population in the new country [58, 130, 132]. In some studies, it is suggested that immigrants have better physical health than the population in the new country, {Abraido-Lanza, 1999 #2022; [58, 100, 106-111, 113, 114, 132, 136-141], a “healthy migrant effect” [58, 103, 110, 113, 137, 139, 142], which is hypothesized to be a result of those who manage to migrate being healthier than their compatriots [58, 137] as ill health is likely to limit migration. However, there is a weakness in these studies describing a “healthy migrant effect”; they compare immigrants with natives of the new country and not natives of the country of birth. However, there is very limited evidence from studies comparing immigrants with natives in the country of birth. One such rare project was the Honolulu Heart Program (HHP). This was a long-term prospective epidemiologic program of CVD in male descendants of Japanese migrants to Hawaii in 1966–1972. Since then, several studies based on material from this program have been published. In a review of these studies [101] a Japan-Hawaii-California gradient of CHD risk factors, morbidity, and mortality rates was described, with the lowest mortality in Japan [143, 144].

1.3.2 Limitation of studies of immigrants and CHD

The true picture of CVD and CHD morbidity and mortality in immigrant is still obscure though there is an increasing number of studies in this area. Those studies performed usually have methodological limitations: first, studying small samples, focusing on a single immigrant group in a local area, or pooling all immigrants into a single foreign-born group. This is not optimal since immigrants are very heterogeneous, possess different backgrounds, and different potential to succeed in the new country. Secondly, socio-economic status (SES) as level of education and unemployment has usually not been taken into consideration. Further, earlier studies are often based on information about health obtained by self-reports {[112, 117, 145-149]. These data might be difficult to interpret because the expression “health” is subjective and may be influenced by cultural tradition [150-157]. It is easier to interpret and draw conclusions from more objective variables. There are few studies of CHD among immigrants comparing mortality in CHD between immigrants in a new country with corresponding compatriots in the country of birth, few studies looking at trends in CVD and CHD among immigrants, and, at last, few studies on the incidence of risk factor among immigrants.

In this thesis we have used the whole Swedish population, subdivided immigrants into eight to twelve groups according to country of birth, limited the use of self-reported and subjective parameters, and adjusted for socio-economic status.

2 AIMS

2.1 GENERAL AIM

The general aim with this project was to elucidate cardiovascular (CVD) and coronary heart disease (CHD) morbidity and mortality among immigrants in Sweden.

2.2 SPECIFIC AIMS

2.2.1 Study I

The aim of Study 1 was to estimate whether immigrants have higher incidence or risks of CVD and CHD than Swedes, adjusting for age (Model I), but also for socio-economic status (Model II).

2.2.2 Study II

The aim of Study 2 was to determine whether all-cause or CHD mortality rates differ between immigrants in Sweden and the population in the country of birth.

2.2.3 Study III

The aim of Study 3 was to analyze the trend in morbidity from CHD among immigrants during the 1990s, and to see whether the changes in morbidity remain after accounting for socio-economic status.

2.2.4 Study IV

The aim of Study 4 was to analyze whether there is an association between country of origin and unhealthy behaviors and risk factors, also after taking socio-economic status into account.

3 MATERIALS AND METHODS

3.1 MATERIALS

The material in this project is taken from three different databases, MigMed, SALLS and WHOSIS. Study 1 and Study 3 are based on MigMed data only, in Study 2 we use data from MigMed and WHOSIS, and in Study 4, data from the SALLS database are used. In the following sections we describe these three databases in more detail.

3.1.1 MigMed

MigMed is a database of the whole Swedish population, resulting from linkage of information from several national registers such as the Register of the Total Population (RTP), the Cause of Death Register and the In-Care Register. Information about age, gender, level of education, occupation, diagnoses of hospital admissions, and cause of death has been filed in this register annually.

3.1.1.1 *The Register of the Total Population*

The Register of the Total Population (RTP) is a register that consists of information about all Swedish citizens and all individuals who have been assigned a personal identification number, which usually occurs after twelve months in Sweden. Information about age, gender, level of education, and occupational status for this project was originally taken from this registry.

To be registered as an immigrant or emigrant one has to have the intention to stay in Sweden or abroad for at least one year. The year of immigration is defined as the year the immigration is registered at the taxation authority, and when a person emigrates, the registration ceases on departure. If a person moves to another Scandinavian county, the registration ceases when he or she is registered in the new country [2].

The registration of data on the population is performed at local taxation authorities and the data are continuously updated. Data registered in the national registration are name, identification number, address, parish, and municipality where a person is registered, wife, husband or registered partner, children, parents, guardians, place of birth, citizenship, civil status, and date of immigration. Information about deaths, emigration, or non-existence is also registered and leads to exclusion in calculations of the total population. When information is changed, the old information is saved [158].

3.1.1.2 *The In-Care Register or Hospital Discharge Register*

In Sweden the collection and recording of information about diseases and treatments has a long tradition going back approximately 100 years. Individual patient recording started in 1962. Since 1987 information has been recorded about all admissions to public hospitals including data on diagnoses, dates of admission and discharge, identification number, sex, age, place of residence etc, according to WHO

recommendations and the International Classification of Diagnoses (ICD9 and ICD10). Information about approximately 1.5–1.7 million hospital admissions is recorded per year [159]

3.1.1.3 The Cause of Death Register

In cases of death, this has to be confirmed by a physician. The reason for death has to be reported and if no reasonable cause of death is found, an autopsy has to be performed. The death has to be reported by letter to Statistics Sweden, which excludes the dead person from the RTP, and the cause of death to the National Board of Health and Welfare.

The Cause of Death Register is kept by the National Board of Health and Welfare., and comprises all deaths in Sweden, and all associated causes of death, irrespective of whether the death occurred in Sweden or abroad for those who were registered in Sweden at the time of death.

3.1.2 WHOSIS

The WHO Statistical Information System, WHOSIS, produces epidemiological and statistical information and makes it available to the public. Indicators cover socio-economic development, environment, health resources, health services, and health status (including data such as GDP, literacy, mortality, number of hospitals, health expenditures). WHO contacts Member States directly, at a national level and through local authorities, and on a routine basis to obtain the latest cause of death data from their vital registration sources. Data submitted by Member States become part of WHO's unique historical database on causes of death, which contains data as far back as 1950.

3.1.3 SALLS

The SALLS (the Swedish Annual Level of Living Survey), is based on material from annual nationally performed face-to-face interviews of people aged between 27 and 60, performed by trained interviewers, about their living conditions, social, lifestyle, and health indicators. The original purpose of the interviews was to obtain information about the standard of living in the country. A randomized selection of approximately 7,600 residents of Sweden, from the Registry of the Total Population, aged 18–84, is made annually. From 1979 onwards, the SALLS extended the yearly survey with regularly recurrent themes (every eight years), e.g. SALLS Immigrants (1996) and SALLS Physical Activity in 1996, 1997, 1999 and 2002. Transculturally adapted professional translations are made from Swedish into the languages needed [160]. The response rate among immigrants has been about 68%, with small variations between immigrant groups. The mean response rate among Swedish controls was recently about 79.0%. About half of the non-respondents among immigrants refused to participate and the other half could not be located. Those not located might have returned to their countries of origin without informing the Swedish authorities. In an earlier SALLS, an analysis of the drop-out concluded that those who refused to participate (2/3 of non-responders) had the same mortality rate

as the respondents, whereas the other two groups (those who were not found and those who were ill) had significantly higher mortality.

3.2 METHODS

3.2.1 Definitions

3.2.1.1 Outcome variables

Internationally, diagnosis of diseases and deaths is preferably done in accordance with the rules of the ICD10 (which includes about 10,000 classifications). ICD10 was adopted in 1990 by the World Health Assembly and came into effect from 1993, replacing the ICD9 (which included about 5,100 classifications). The number of countries complying with the ICD10 has increased from 4 in 1995 to 64 in 2001 and there are still around 50 countries reporting data using the 9th revision of ICD. Only countries reporting data properly coded according to the revisions of the ICD are included in WHOSIS. Sweden is one of the countries using ICD10. In this project, morbidity is defined, according to ICD10, as the first admission to hospital as a result of CVD or CHD. Further, cause of death is defined, according to ICD10, as “the disease or injury” that initiated the train of morbid events leading directly to death, and in this project to death by CVD or CHD.

CVD comprises diseases such as acute rheumatic fever, chronic rheumatic diseases, hypertensive diseases, ischemic heart disease or CHD, pulmonary circulatory diseases, other heart diseases, cerebro-vascular diseases, arterial, arteriolar, and capillary diseases, and some of the diseases of the venous system. CVD is the major cause of morbidity and mortality in the Western world, closely followed by the sub-group CHD, the largest (50%) of all the subgroups. CHD is closely related to situations of increased physical and psychological stress, and might therefore be indirectly associated with the stressful life as an immigrant in a new country. For this reason, we chose to study CVD and CHD among immigrants in Sweden. CVD and CHD morbidity or mortality was the main outcome variables in Studies 1–3. CVD was defined according to ICD10 (I00–I82), (ICD9 390–458), and CHD according to ICD10 (I20–I25), (ICD9 410–414).

Risk factors for CVD and CHD were defined, smoking as non-smokers or smokers, obesity according to Body Mass Index, $BMI \geq 30$, having or not having diabetes or hypertension, or leisure-time physical activity (physically inactive and active). Person-year at risk was used as the measure of time, and was calculated for all subjects, from inclusion to the first CVD or CHD event or to death, due to any cause or to contracting CVD or CHD. Out-of-hospital morbidity in CVD or CHD or deaths was not included, i.e. about 1.9% of all fatal and non-fatal CHD events.

3.2.1.2 Explanatory variables

To analyze huge datasets at individual level requires computerized calculation programs when aggregating data the analyses is possible to perform manually. When analyzing the data manually, age was categorized into 5-year intervals and eight age groups were constructed: 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, and 70–

74, six out of these chosen to study. We excluded individuals younger than 35 because morbidity and mortality from CVD and CHD are rare in the youngest age groups, and individuals older than 64 because this is the age of retirement, when we wanted to adjust for occupational status, or ≥ 74 if not. There was a problem in including enough countries from the WHO database, and at the same time reliable amount of data from each MigMed immigrant sub-group. The reliability of data from MigMed was increased by maximizing the size of study cohorts of immigrants, by making the age span as large as possible, with the result that subjects between 45 and 74 years of age were selected. In Study 4, the problem was similar to that in Study 2, so we made an effort to ensure that each sub-group of immigrants was not too small to assess a specific risk factor. We therefore categorized the study population in Study 4 into three age groups, 27–34, 35–44, and 45–60 years of age.

In all studies, we stratified our data for sex, as there is a difference between the sexes in the age at which the onset of illness occurs, in lifestyle and other associated risk factors for these diseases.

Immigrants were defined as persons born abroad and not having Swedish parents, i.e. first-generation immigrants. The country of origin or birth was defined as the country in which the person was born. This definition differs from that of SCB that is that a person must intend to stay in Sweden for at least one year and might be a Swedish citizen. To be registered as an emigrant, a person must intend to settle abroad for at least one year.

Immigrants were subdivided into groups according to their country of origin. When the number of subjects from a single country was too small, single countries were fused into larger groups of countries, on the assumption of geographical, cultural, religious, and economic similarities. OECD countries were categorized according to cultural, economic, and religious traditions; Southern Europe was categorized according to geographic location along the Mediterranean, the Mediterranean culture, and Christian religion, Eastern Europe according to its geographic location and cultural, economic, and religious traditions with reference to the former Eastern bloc, and finally Latin America, Iraq/Arabic-speaking countries, Asia and Africa according to their geographic location and cultural, economic, and religious traditions. In Studies 1 and 3, thirteen countries, or groups of countries, were defined: Sweden (reference group), Finland, OECD (e.g. USA, Canada, Australia, New Zealand, Japan and Western Europe except for Finland and Southern Europe), Southern Europe (Portugal, Spain, Italy, Cyprus, Greece, Israel, and the former Yugoslavia), Eastern European countries (Estonia, Latvia, Lithuania, Romania, Slovakia, the Czech Republic, Hungary, Albania, Bulgaria, Croatia, Macedonia, Moldavia, Slovenia, Russia, the Soviet Union, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kirgizstan, Tadjikistan, Turkmenistan, Ukraine, Uzbekistan but not Poland), Poland, Turkey, Iran, Latin America, Iraq/Arabic-speaking countries, Bosnia (only in the first study), Asia (except for Turkey, Iraq, Israel, and Arabic-speaking countries) and Africa (except Arabic-speaking North Africa). In Study 2, we were limited to studying a few culturally, economically, and politically quite similar countries. The limitation in the countries that could be studied was, firstly, caused by lacking mortality data on some of the countries in the WHO database, and secondly, caused by too small a number of CHD cases in some immigrant groups to obtain reliable estimates. Consequently, countries too small to give a reliable number of CHD cases were excluded from the study or fused into larger groups of countries. One way to increase the number of countries included was to expand the study period into eight years in MigMed. Finally, eight countries or group of countries were possible to study: Norway, Denmark, Finland, Germany, Poland, Hungary, Southern Europe, and Chile. In Study 4, the number of interviews was too small (7000 yearly)

to obtain reliable estimates of the smallest immigrant groups living in Sweden. We were limited to defining only eight immigrant groups, alongside a Swedish-born reference group: Finland; OECD; Southern Europe; Eastern Europe; Poland; Turkey; Iran, and Chile. Poland, Turkey, Iran; and Chile could be included, despite the small sizes of these groups living in Sweden, owing to the specialized surveys of SALLS focusing on immigrants only.

We adjusted the samples for socio-economic status (SES) in Studies 1, 3, and 4, defined as attained level of education and occupational status. According to level of education, the subjects were divided into three groups: (1) primary school or less (≤ 10 years); (2) completed secondary or high school (11–14 years); (3) completed college or university studies (≥ 14 years). Occupational status was defined in studies 1, 3, and 4 as (1) employed or (2) non-employed. In Study 2, there were no such variables in the WHO database, although this was not adjusted for.

Information about social network was only assessable in Study 4, and was defined as weak or strong. A strong social network was defined as personal or telephone communication with at least three of the sub-groups of relatives—neighbors, brothers and sisters, children and friends—at least once a month.

3.2.2 Study design

The following part is subdivided into two sections. In the first section the original results are presented by study. In the second section the results from all studies are presented by country of origin and sex (Summary of Studies 1–3).

3.2.2.1 Study 1

This study was a survival analysis of morbidity and risks of CVD and CHD among thirteen immigrant groups in Sweden, aged 35–64, based on cases occurring between 1 January 1997 and 31 December 1998. The data were taken from the MigMed database. The results of the morbidity were presented as age-adjusted incidence rates (IR) and the results of the risks as hazard ratios (HR). Cases were defined as first admission to hospital because of CVD or CHD, and IR as cases per 1000 person-years at risk. Individual data on person-years at risk were calculated from 1 January 1997 until the first CVD/CHD event, or until death for any reason, and subjects who did not contract CVD/CHD were censored at the end of the study period (31 December 1998). Further, HRs were calculated using the Swedish natives as a reference population. The age-adjusted IRs were calculated by indirect standardization using Swedes as the standard population. The Cox PH Regression Model was used to analyze the HR with 95% confidence intervals (CI). The results are presented in two different models; the first an age-adjusted model, adjusted for country of birth, attained level of education and occupational status separately and the second full model adjusting for all these factors at once. Women and men were analyzed separately. There were no first-order interactions between age, place of birth and SES.

3.2.2.2 *Study 2*

In Study 2, the age-adjusted all-cause and CHD mortality was first analyzed among immigrants in Sweden and compatriots in the country of birth, secondly, the relative risks between these two groups were analyzed. The sample was based on two large databases, the MigMed, and data from WHO [161]. Information was taken from the WHO database in 1995, and from MigMed during eight years, 1991–1998.

The different design of study periods between the databases was performed to include enough number of countries, and at the same time to include large enough populations, in the end, to get statistical reliably estimates. There were a limited number of countries represented in the WHO database. In the MigMed, some immigrant groups were too small to get reliable number of deaths in CHD according to the size of the immigrant population. Many of the largest immigrant groups in Sweden were not represented in the WHO database, and those represented in the WHO database were small immigrant groups in a Swedish perspective. The only way to deal with this, was to enlarge the immigrant groups in Sweden by expand the actual study period. But it was not possible to expand the study period in the WHO database in the same way though only data until 1995 was represented when the study was performed. And it was not possible to bring the study forward though the MigMed database is established in 1991. By including from both databases only during 1995, the size of the immigrant populations in Sweden would have been too small. Therefore we expand the study period of immigrants in Sweden into eight years, 1991-1998, with the median year of the study period in 1994/1995, estimated to be comparable to the data of WHO in 1995.

Each of the eight calendar years studied in MigMed comprised an independent sub-study period, with inclusions into the study on 1 January and termination on 31 December. The results from all eight independent sub-study periods were finally summarized to form a single large MigMed cohort. Persons aged 45 to 74 were included in both the WHO and MigMed cohorts. We estimated the total amount of person-years at risk, in both databases, as the size of the population. Age-adjusted total and CHD mortality rates, which were analyzed by indirect standardization using the total Swedish population in WHO as the reference, and OR (95% CIs) were analyzed by the Poisson regression model. HR was analyzed for each single country using natives in the country of birth as references [162].

To ensure that the mortality between the datasets were comparable, e.g. that the eight year study period in MigMed (1991–1998) could be compared to the WHO data in 1995, we used the mortality rates for Swedes in the MigMed and WHO databases, to validate the data. The mortality rates of Swedish-born subjects in MigMed (immigrants excluded) and the mortality rates of all Swedish citizens (immigrants included) in the WHO database, should approximately be the same, if the study periods could be assessed as comparable.

3.2.2.3 *Study 3*

Study 3 is a follow-up study of the trend of CVD and CHD among eleven immigrant groups in Sweden during 1990s. The material is based on the MigMed database. Men and women aged 35–74 were included in the study. Two study periods were defined; the first from 1 January 1991 to 31 December 1993, and the second from 1 January 1997 to 31 December 1999. The first study period, 1991–93, was the reference

period. Each study period comprised three independent sub-periods, one for each calendar year. The inclusions in sub-study periods were separated from each other, starting on 1 January each year, and terminating on 31 December the same year. Approximately 4 million subjects were included into each of the two study periods, 1991–1993 and 1997–1999, of whom approximately 12% were immigrants.

In the first step in the study, the age-adjusted incidences were analyzed by indirect standardization using Sweden as a standard population. In the second step, age-adjusted OR with a 95% CIs, between 1991–93 and 1997–99, were analyzed by the Poisson regression model, using 1991–93 as reference (Model I). In the third step, adjustments for level of education and unemployment were also made (Model II).

Model II was mainly constructed to check for major changes between the two study periods, due to major changes of the populations, e.g. changes in level of education, changes in living conditions, changes in employment status, or changes in ethnic composition of the immigrant group due to further waves of immigration.

3.2.2.4 *Study 4*

Study 4 is a cross-sectional study of prevalence, and prevalence ratios (PR), of lifestyle- and risk factors of CHD, among eight immigrant groups in Sweden. The material is based on the SALLS, a yearly interview survey by Statistic Sweden. This study was performed between 1 January 1996 and 31 December 2002. We focused on questions about smoking, overweight, physical activity, hypertension and diabetes, and limited the study to immigrants from OECD, Finland, Southern Europe, Eastern Europe, Poland, Turkey, Iran, and Chile, because of statistically too small sample sizes in other immigrant groups. Subjects aged between 27 and 60 were included, although this is the age span used in SALLS Immigrants. Finally, 24,000 men and women were included, of whom 80% were Swedes. The Swedish group acted as references.

The analyses of SALLS and SALLS Immigrants were performed separately with Swedish-born subjects as references in both groups. The data were sub-categorized according to sex and country of birth. Three age strata were used, 27–34, 35–44, 45–60, limited to ensure that the strata were not statistically too small. In the first step, age-adjusted prevalence was analyzed by indirect standardization. In the second step, the age-adjusted PR was analyzed by a log-binomial model, and in the third step, PR was also adjusted for age, level of education, employment status and social network. When the number of cases in strata became too small, crude prevalences were estimated, as was the case in the diabetes and hypertension groups. When the data did not converge, a logistic regression model was used in which the prevalence ratios were approximated by odd ratios (obesity, hypertension, and diabetes). This is a good approximation when the prevalences are <10%. The results are presented as prevalence ratios (PR) with 95% CIs.

3.2.2.5 *Summary of Studies 1–3*

We tried to embrace the results of Studies 1–3, by comparing the age adjusted mortality risk of CHD in the country of origin compared to Swedes with the age-adjusted morbidity and among immigrants in Sweden, in 1991–93 and 1997–99, using Swedes in 1991-1993 as references and presented in a diagram, for each country separately.

The study is designed as a follow-up study of mortality risk and morbidity trend of CHD among eight immigrant groups in Sweden and in their country of birth. The material is based on the WHO, SCB and the MigMed databases. Men and women aged 45–74 were included in the study. Three study cohorts were defined; the WHO cohort for 1991–1993, the SCB/MigMed cohort for 1991–1993, and the SCB/MigMed for 1997–1999. Sweden was the reference of the WHO cohort, and Swedish born subjects in 1991–93 were the references of both the 1991-93 and 1997-99 immigrant cohorts. Each study cohort comprised of three independent sub-study-periods, one for each calendar year. The inclusion to the sub-study periods were separated from each other, starting on 1 January each year, and terminating on 31 December the same year.

3.2.3 Statistical Models

3.2.3.1 Study 1

This study was about morbidity in CVD and CHD among twelve immigrant groups in Sweden. The data was collected at an individual level, on length of time spent in the study until event, withdrawal, or the end of the study (survival analysis). To assess the risk of falling ill compared to the reference population, the Cox Proportional Hazard Regression Model (Cox PH Regression Model) was used, which has been developed to handle individual data, deduced from the Mantel-Haenszel proportional or incidence-curve. In the first model (Model I), we adjusted the data for age and immigrant status, education, or unemployment. In the second model (Model II) adjustments were made for age, immigrant status, education, and unemployment all together.

3.2.3.2 Study 2

The second study was about total and CHD mortality differences between immigrants in Sweden and in the country of birth. In this study we had no individual data on time as in the first study, but time of total populations, and therefore the Poisson Regression Model was chosen. The outcome was primarily measured as the prevalence of CHD, and secondarily, incidence density ratios were analyzed. The sample was adjusted for age.

3.2.3.3 Study 3

The third study compared morbidity in CVD and CHD between 1991–93 and 1997–99 in twelve immigrant groups and Swedes. The results were presented as odd ratios. We were able to use individual data on time, but in order to do the analyses of the material manually, we chose to use the Poisson Regression Model. In the first model only adjustments for age and country of birth were made. In the second model we also adjusted for level of education and unemployment.

3.2.3.4 *Study 4*

The fourth study is a study of differences in the prevalence of risk factors for CHD between immigrant groups in Sweden and Swedes. The Log Binominal Model, a generalized linear model with logarithmic link function and binominal distribution, was used to analyze prevalence proportion ratios and adjust for several confounders. [163]. This model was developed to analyze cross-sectional studies. It does not produce standard errors as large as the Cox PH Regression Model, and does not estimate the prevalence at above 1 when the prevalence is high, as is the case with the logistic model [163].

3.2.3.5 *Summary of Studies 1–3*

In this study we tried to summarize the results by illustrating the morbidity and mortality risk of CHD, in the country of origin, among immigrants in Sweden, and the time trend, for each immigrant group separately. Age-adjusted mortality data in 1991–93 (WHO) were compared to Swedish references in 1991–93 (SCB). An age span of three years was used to enlarge the material, important especially among the immigrants in Sweden, in order to make the results statistically reliable. We also used this time span throughout the study to make the results as comparable as possible. We were restricted to using data on mortality because data on morbidity were not accessible in the WHOSIS. Further no mortality data according to country of birth were available at the time of printing this thesis. Secondly, age-adjusted morbidity data for 1991–1993 and 1997–1999, using Swedes in 1991–1993 as references, were analyzed. In a first step, the age-adjusted number of deaths were analysed by indirect standardisation. In a second step, OR with a 95% CIs were analysed. All the results were presented in diagrams, for each country separately.

3.3 ETHICS

Approval for all procedures has been secured from the Ethics Committee at Huddinge University Hospital, Karolinska Institutet. reg. no. 11/00, 6 March 2000.

4 RESULTS

We try here to illustrate all the results in figures. If the tables are required, they can be found in the appendix at the end of this thesis.

4.1.1 Study 1

In Study 1, we analyzed the morbidity and relative risks of CVD and CHD among immigrants in Sweden compared to native Swedes.

The results show almost twice as high incidence rates of CVD among immigrant men in Sweden as among immigrant women. The median incidence rate for men was 14.24 (range 8.79–18.94), and for women 8.15 (range 4.35–11.80) cases per 1000 person-years at risk. Immigrants from Latin America had the lowest incidence rates, and the highest incidence rates were found among immigrants from Finland, Poland, Bosnia, Turkey, Asia, and Iraq, both sexes included, and among immigrant women from Iran. Among men and women from Sweden, OECD countries, Southern Europe, Eastern Europe, Africa, and Iran, the CVD incidence rates were close to the median (table 1 in appendix I, p 238).

Men had almost twice to three times as high incidence rates of CHD as women. The median incidence rate for men was 9.15 (range 4.69–11.48), and for women 2.95 (range 1.53–5.47) cases of CHD per 1000 person-years at risk. The lowest incidence rates were observed in the African immigrant group, in both men and women. Immigrants from Finland, Poland, Bosnia, Turkey, Iran, and Iraq, both sexes included, along with immigrant men from Southern Europe, had the highest incidence rates of CHD. For Swedes, immigrants from OECD, Eastern Europe, and Asia, incidence rates close to the median were observed (table 2 in appendix I, p 239).

The age-adjusted risk of falling ill with CVD was, in general, higher among immigrants, e.g. in immigrants from Finland, Southern Europe, Poland, Bosnia, Turkey, Arabic-speaking countries, both sexes included, in Eastern European and Asian men, and in Iranian women, than in Swedes. Among immigrants from OECD and Africa, in both men and women, the risk did not differ from that for the Swedes, and the same applied to immigrant women from Eastern Europe, Asia, and Latin America and immigrant men from Iran and Southern Europe. In immigrant men from Latin America, the risk was lower than in Swedish-born people (figure 8.1; table 3 in appendix I, p 240).

The age-adjusted risk of CHD was in general higher in immigrants than in the Swedes, e.g. in immigrants from Finland, Southern Europe, Poland, Bosnia, Turkey, Iran, Arabic-speaking countries, both sexes included, and in men from OECD, Eastern Europe, and Asia, than in Swedes. The risks for immigrant men and women born in Latin America, and Africa, and for immigrant women from OECD, Eastern Europe, and Asia, did not differ from those for the Swedish-born people (figure 8.1; table 3 in appendix I, p 240).

In the full model, after adjustment for age, education, and unemployment (model II), the high risks of CVD remained for immigrant men and women from Finland, for immigrant men from Poland, Turkey, Arabic-speaking countries, and Asians. The risk of CVD was lower for immigrant men and women from Latin America, for immigrant women from OECD, and Africa, and for men from Southern Europe, than among Swedish natives. The risk of CVD was about the same as for Swedish references, for men and women born in Eastern Europe and Iran, for immigrant men from OECD, Bosnia, Iran and Africa and for immigrant women from Southern

Europe, Poland, Turkey, Iraq, Arabic-speaking countries, and Asia (figure 8.2; table 3 in appendix I, p 240).

For immigrant men and women from Finland, Poland, Bosnia, Turkey, Iran, and Iraq/Arabic-speaking countries, and for immigrant men from OECD, Southern Europe, Eastern Europe, and Asia, there was an excess risk of CHD, also after adjustment for SES. In immigrant men and women from Latin America and Africa, and in immigrant women from OECD, Southern Europe, Eastern Europe, and Asia, the risk of CHD did not differ from that for the Swedes (figure 8.2; table 3 in appendix I, p 240).

Figure 8.1 Age-adjusted Hazard Ratios (Model I) of CVD and CHD among twelve immigrant groups in Sweden compared to the Swedish references, men in blue, women in red.

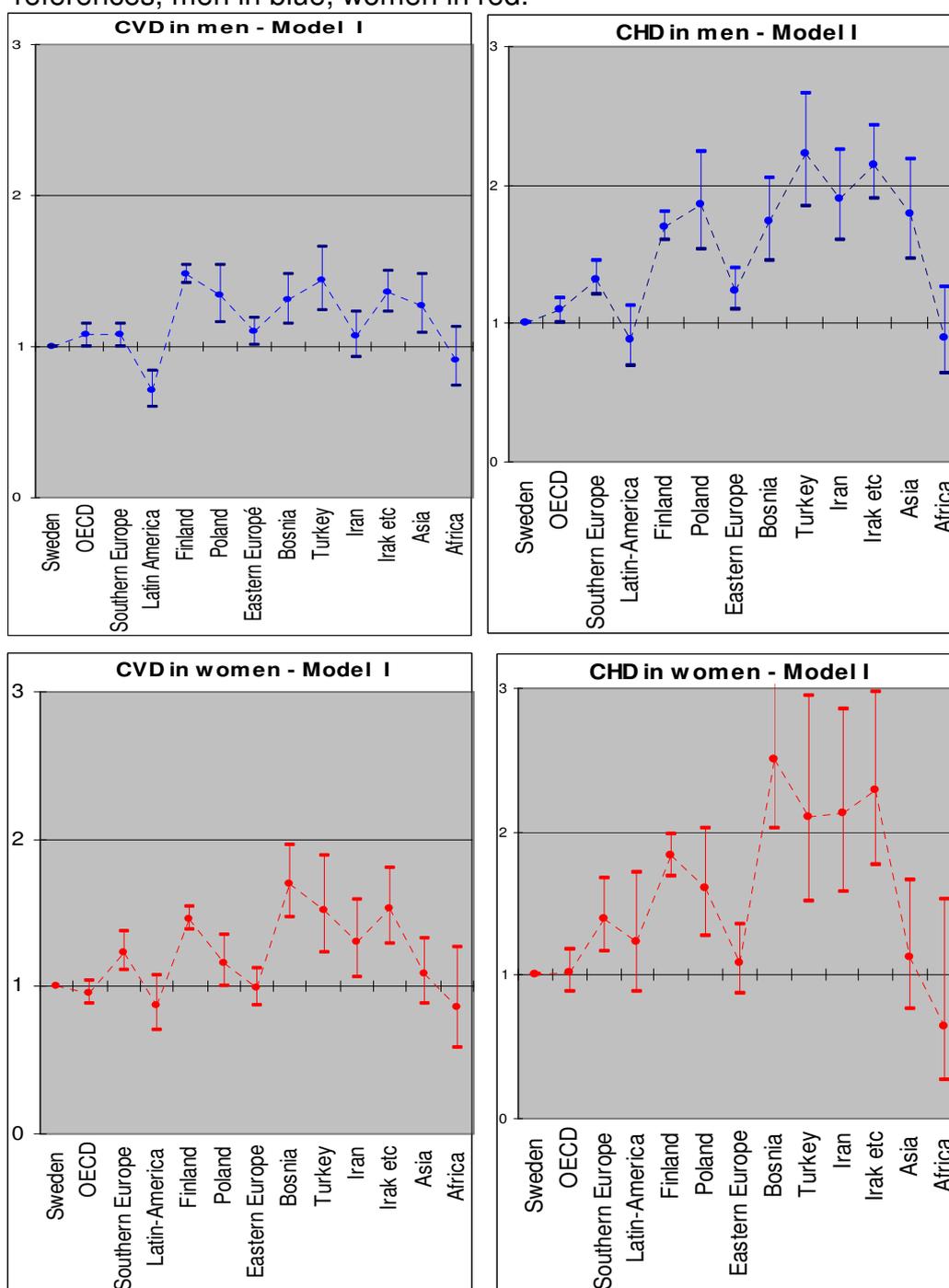
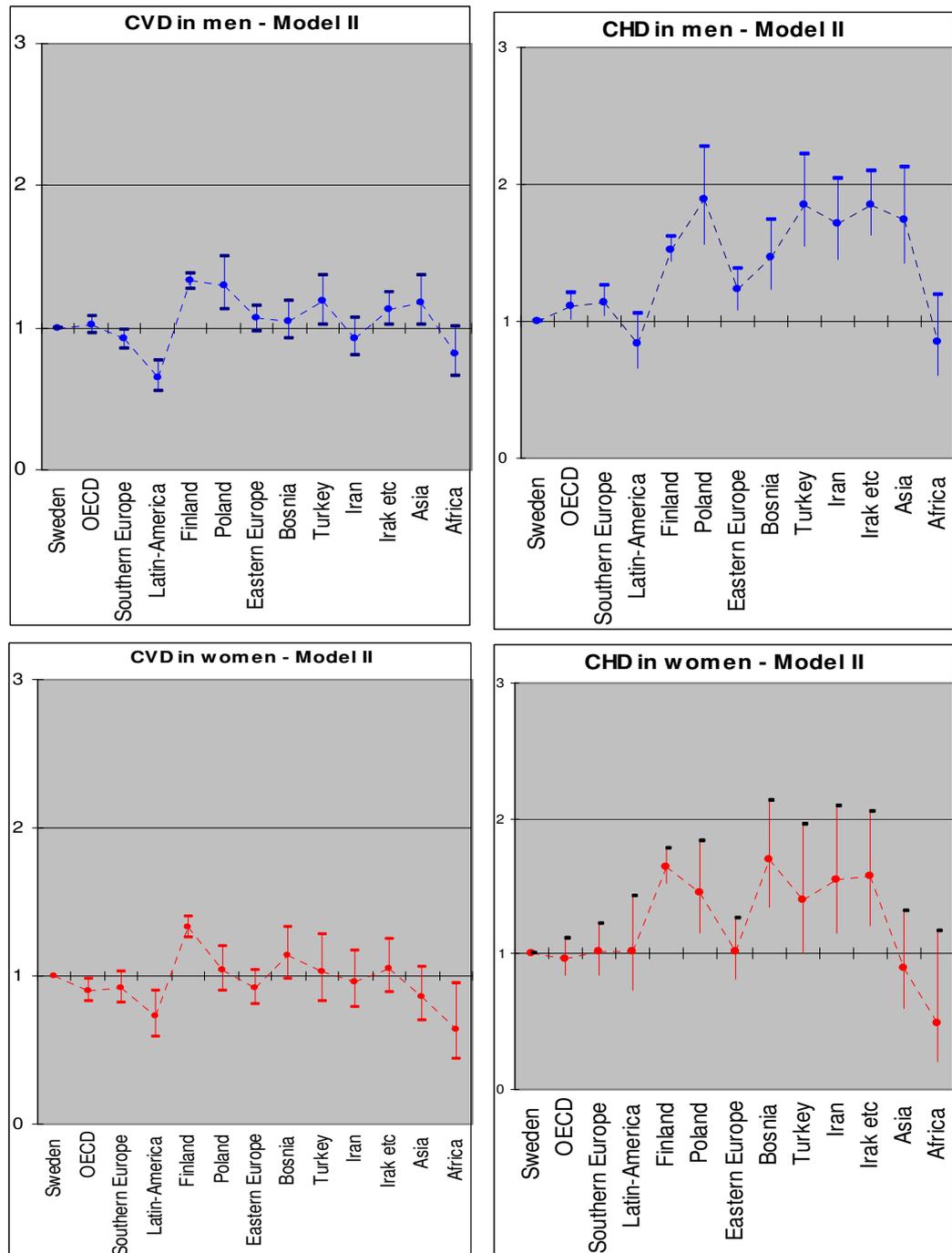


Figure 8.2 Hazard Ratios of CVD and CHD among twelve immigrant groups in Sweden compared to Swedish references, adjusted for age, education, and unemployment (Model II), men in blue, women in red.



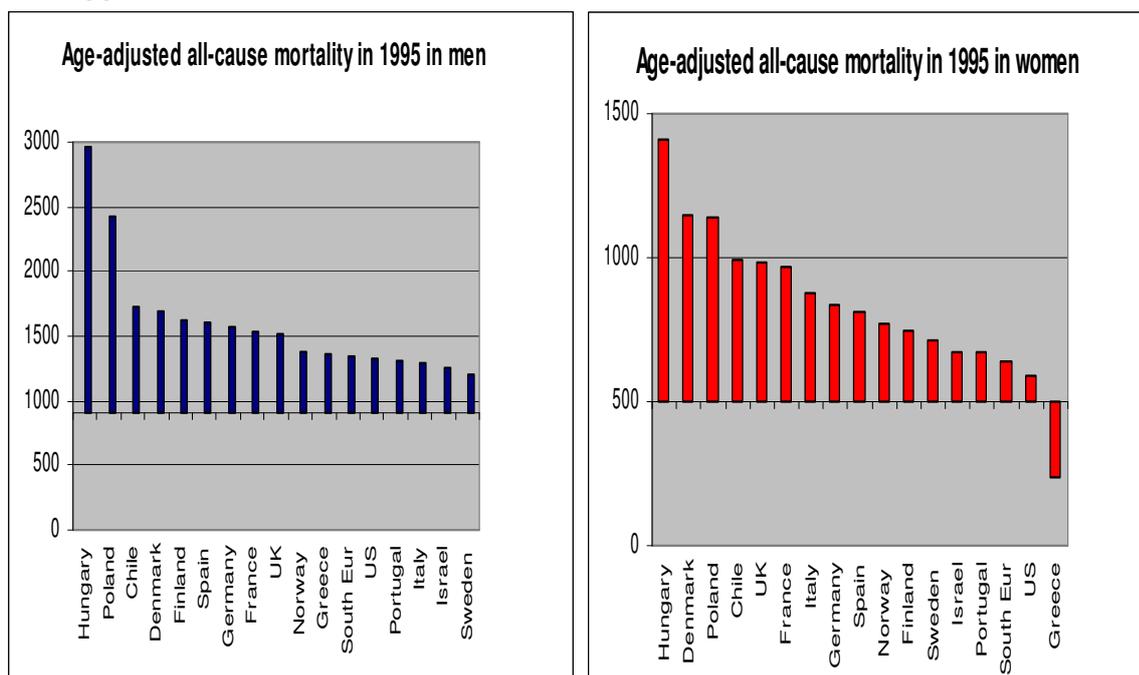
4.1.2 Study 2

In Study 2, we made a comparison of all-cause and CHD mortality between immigrants in Sweden and corresponding compatriots in the country of birth, in the ages 45–74. The number of person-years at risk, all-cause, and CHD deaths, age-adjusted all-cause and CHD mortality in different immigrant groups in Sweden and in the countries of birth are shown in (table 1 in appendix II, p 17).

Among immigrant men in Sweden, all-cause age-adjusted mortality rates ranged between 750 and 1560 per 100,000 years at risk, and among immigrant women between 420 and 830. Highest all-cause mortality rates were seen in immigrant men from Finland and immigrant women from Denmark, and lowest rates in immigrant men and women from Chile. CHD mortality rates among immigrant men ranged between 750 and 1560, and between 420 and 830 per 100,000 years at risk among immigrant women. The highest CHD mortality rates were seen in immigrant men from Finland and immigrant women from Denmark, and lowest rates in immigrant men and women from Chile (table 1 in appendix II, p 17).

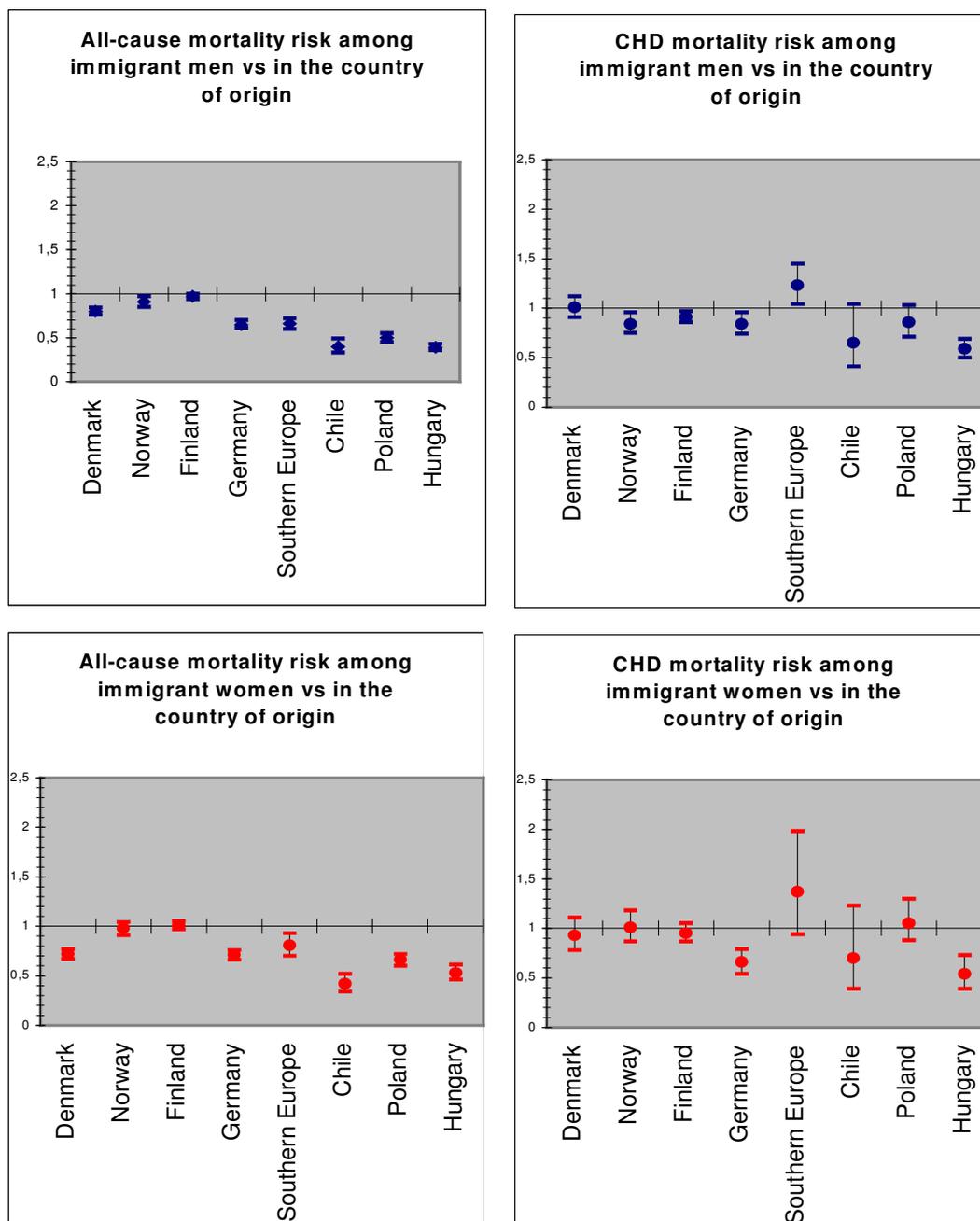
There are obvious all-cause mortality differences between countries. Among men, the all-cause mortality rates ranged between 1200 and 2970, and among women between 640 and 1410 per 100 000 years at risk. The highest all-cause mortality rates were seen in Hungary, both sexes included, and the lowest rates in Swedish men and in South European women. CHD mortality rates ranged between 180 and 640 in men, and between 60 and 270 per 100,000 years at risk in women. Highest CHD mortality rates were seen in Hungary, and lowest rates in South Europe, for both sexes (figure 9.1; table 1 in appendix II, p 17).

Figure 9.1 Age-adjusted all-cause mortality in 17 countries, per 100 000 person-years at risk, in 1995, all ages included, men in blue, women in red.



The all-cause mortality risk was lower in Sweden than in the country of origin in immigrant men and women from Denmark, Germany, Southern Europe, Chile, Poland, and Hungary, and also in immigrant women from Norway. The all-cause mortality risk of CHD was also lower in men and women from Germany and Hungary and in men from Norway and Finland. Immigrant men from Southern Europe had higher risks than in their country of birth. In the remaining groups, the risks did not differ significantly (figure 9.2; table 2 in appendix II, p 18).

Figure 9.2 Relative risk and 95% CIs, of all-cause or CHD mortality among immigrant men and women in Sweden compared to the country of birth.



4.1.3 Study 3

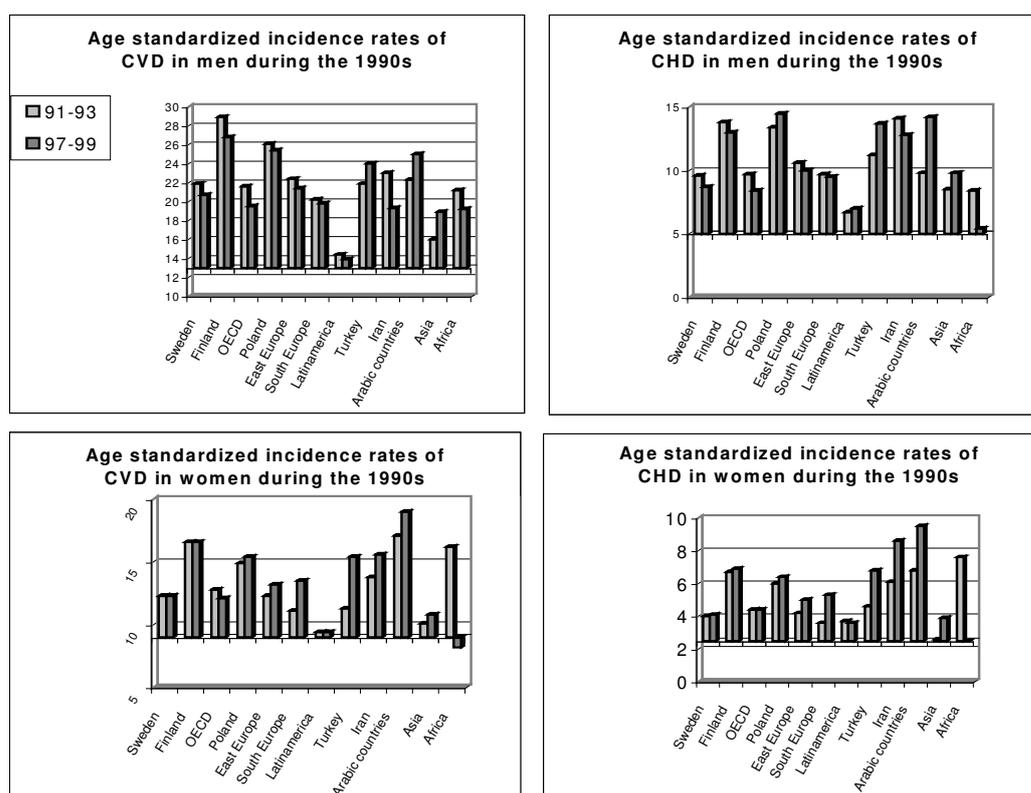
In Study 3, we analyzed the morbidity trend during 1990s in some immigrant groups in Sweden.

The age-adjusted morbidity from CVD decreased in 9 out of 12 male groups, e.g. in males from Sweden, Finland, OECD countries, Poland, Eastern Europe, Southern Europe, Latin America, Iran, and Africa, and increased in 3 out of 12 groups, e.g. in males from Turkey, Arabic-speaking countries, and Asia, during the 1990s. The age-adjusted morbidity from CHD decreased in 7 out of 12 male groups, e.g. in males from Sweden, Finland, OECD countries, Eastern Europe, Southern Europe, Iran, and

Africa, and increased in 5 out of 12 groups, e.g. in males from Poland, Latin America, Turkey, Arabic-speaking countries, and Asia, during the 1990s (figure 10.1; table 1 in appendix III, p 757).

The age-adjusted morbidity from CVD decreased in 2 out of 12 female groups, e.g. in females from OECD countries and Africa, and increased in 7 out of 12 groups, e.g. in females from Poland, Eastern Europe, Southern Europe, Turkey, Iran, Arabic-speaking countries, and Asia, during the 1990s. In the remaining 3 groups, the morbidity remained unchanged, e.g. in females from Sweden, Finland, and Latin America. The age-adjusted morbidity from CHD decreased in 2 out of 12 female groups, e.g. in females from Latin America, and Africa, and increased in 9 out of 12 groups, e.g. in females from Sweden, Finland, Poland, Eastern Europe, Southern Europe, Turkey, Iran, Arabic-speaking countries, and Asia, during the 1990s. In a single remaining group, in females from the OECD countries, the morbidity remained unchanged (figure 10.1; table 1 in appendix III, p 757).

Figure 10.1 Age-adjusted morbidity from CVD and CHD, among eleven immigrant groups in Sweden, and in Swedes, in 1991–93 and 1997–99, men and women separately.



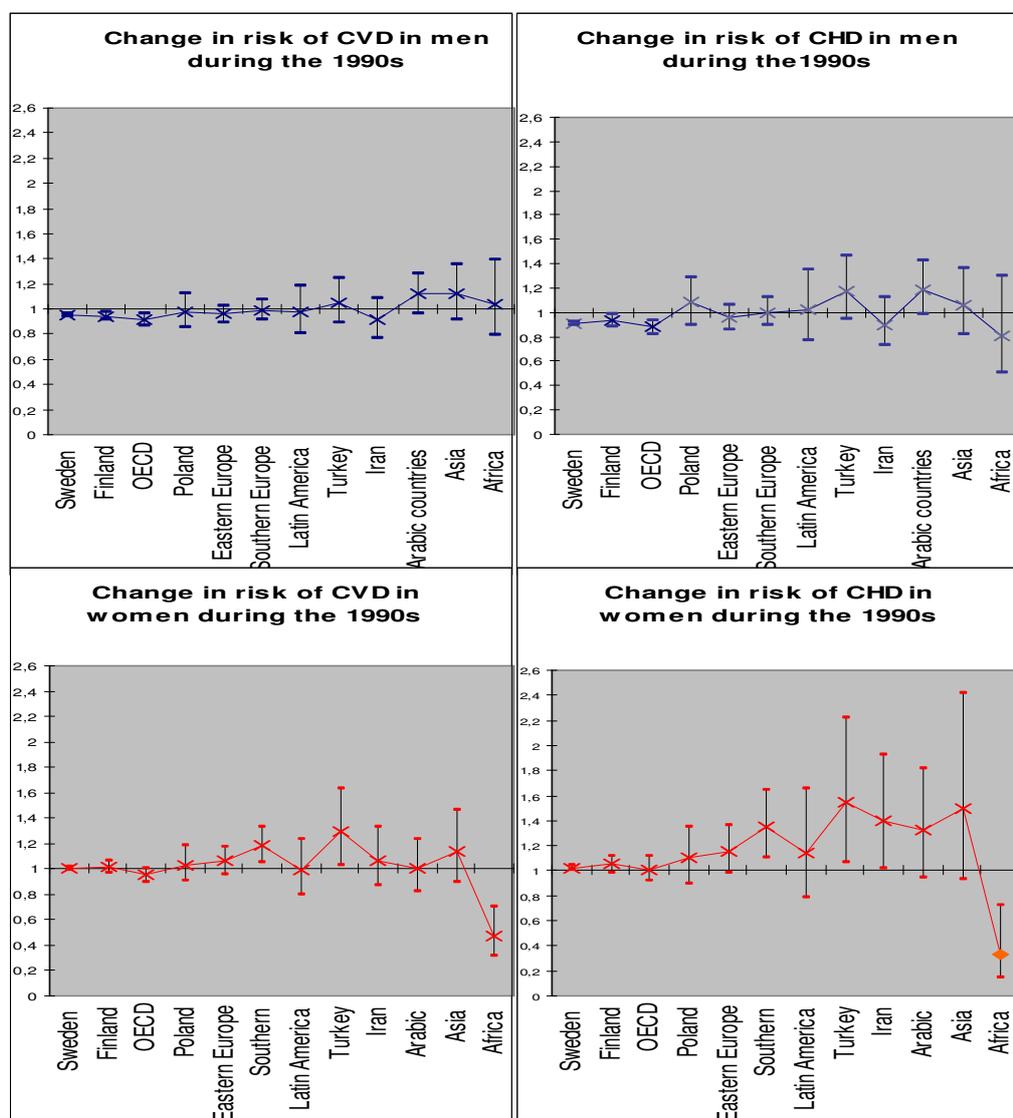
The age-adjusted morbidity from CVD and CHD decreased significantly in 3 out of 12 male groups, e.g. in males from Sweden, OECD countries, and Finland, during the 1990s. In the remaining nine groups, the morbidity remained unchanged (figure 10.2; table 2 in appendix III, p 758).

In contrast to the male groups, the age-adjusted morbidity increased significantly in 2 out of 12 female groups with regard to CVD, e.g. in females from Southern Europe and Turkey, and in 3 out of 12 female groups regarding CHD, e.g. in females

from Southern Europe, Turkey, and Iran. The only female group with significantly decreased age-adjusted morbidity was the African women. In the remaining groups, the morbidity remained unchanged (figure 10.2; table 2 in appendix III, p 758).

On adjusting the data not only for age but also for level of education and unemployment (Model II), there was no significant change in the results compared to those in Model I, except for the morbidity from CHD in Swedish and OECD females. However, the change in these two groups was very small, the limits of the confidence intervals were almost the same as in Model I and very close to one (table 3 in appendix III, p 758).

Figure 10.2 Odd Ratios (relative risks) of morbidity from CVD and CHD, in 1997–99 compared to 1991–93, among eleven immigrant groups in Sweden and in Swedes, men and women separately.



4.1.4 Study 4

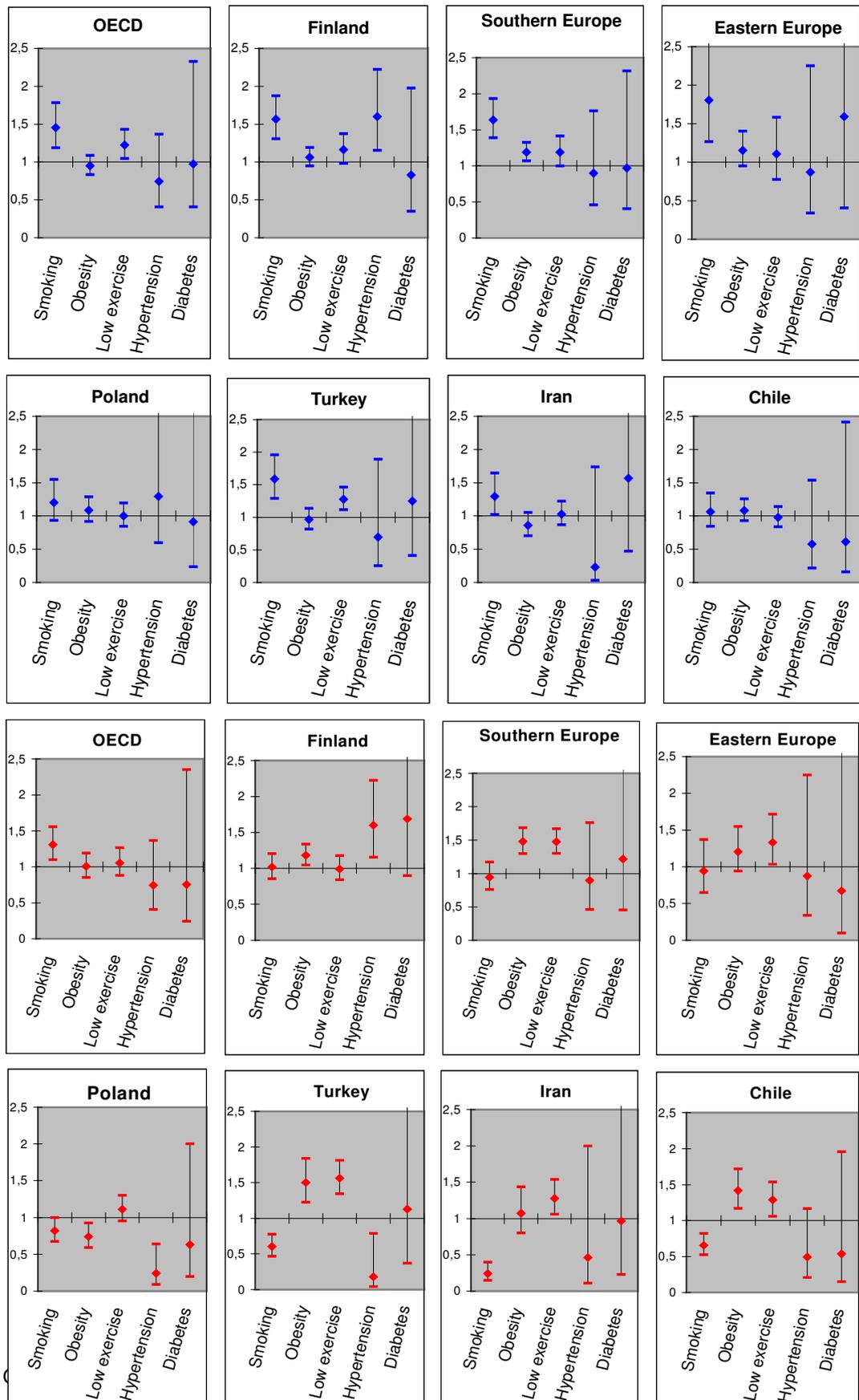
In Study 4, we analyzed risk factors and unhealthy behaviors among some immigrant groups in Sweden.

The age-adjusted prevalences of unhealthy behaviors and (crude prevalences of hypertension and diabetes) CHD risk factors are presented by sex and country of birth in table 1 in appendix IV, p 538.

All groups of immigrant men had higher age-adjusted risks of smoking than Swedish men, with PR ranging between 1.40 and 2.49. Immigrant women from OECD, Poland, and Chile had higher risks of smoking than Swedish women, while women from Iran had a lower risk (0.46: 0.29–0.75). Men from Turkey and Chile ran considerably higher risks of obesity (3.21: 2.25–4.60, 2.78: 1.97–3.92) than Swedish men in an age-adjusted model. The risk of obesity was higher in women from Southern Europe, Turkey, and Chile than in Swedish men in an age-adjusted model. The prevalences of hypertension and diabetes are low in the studied age range, resulting in wide confidence intervals for the age-adjusted risk estimates. Nevertheless, women from Finland had a higher risk of hypertension and diabetes than Swedish-born women (1.83: 1.25–2.67, 1.99: 1.06–3.74), while immigrant women from Poland had significantly lower risks of hypertension than Swedish women. Turkish and Finnish immigrant women had a considerably higher risk of diabetes (2.72: 1.20–6.19, 1.99: 1.06–3.74) than Swedish women. Among men, all groups of immigrants, except those from the OECD countries and Eastern Europe, showed higher risks of physical inactivity than Swedish men, with prevalence ratios ranging between 1.19 and 1.56. Immigrant women showed a similar pattern; all groups except those from the OECD countries and Finland had increased prevalence ratios of physical inactivity ranging between 1.32 and 1.93 (table 2 in appendix IV, p 538).

We also adjusted for level of education, employment status, and social network in a main effect model. The increased risk of smoking among men remained in all groups. Among women from the OECD countries and Poland, the increased risks of smoking and, in women from Iran, the decreased risk of smoking remained unchanged in the main effect model. In the main effect model, the increased risk of obesity remained in men from Chile and in women from Southern Europe, Turkey, and Chile. The increased risk of hypertension among Finnish women and the decreased risk among women from Poland and Turkey remained significant in a main effect model. However, there were no differences in the risk of diabetes between the immigrant groups and Swedish-born in the main effect model. The increased risk of physical inactivity among men remained in men from Poland, Turkey, Iran, and Chile, while men from the OECD countries changed from non-significance to a significant excess risk in the main effect model. Among women immigrants, the risk of physical inactivity remained significant in all immigrant groups (figure 11.1 and 11.2; table 3 in appendix IV, p 539).

Figure 11 Prevalence Ratios (relative risks) of unhealthy behaviors and risk factors of CHD, in eight male and female immigrant groups in Sweden compared to Swedish men and women, adjusted for age, education, unemployment and social network (model II).



In additional analyses (not shown), including only the immigrant groups, the time in Sweden did not change the risks in the different outcomes, except for smoking in men: the longer the time in Sweden, the lower the risk of smoking.

4.1.5 Summary of Studies 1–3

In this section, all the results from Studies 1–3, for each immigrant group separately, are presented in the same figure, *Figure 1-3*. The first dot in the diagram, represents the relative risk of mortality in CHD in a specified country compared to in Sweden. The second dot is the morbidity among the specified immigrant group in Sweden in 1991-93 compared to the Swedish born references in 1991-93. The third dot is the morbidity among the specified immigrant group in Sweden in 1997-99, compared to the the same reference as for the second spot, the Swedish born references in 1991-93.

Immigrant men

The morbidity in CHD is decreasing among Swedish men during the 1990s.

In Finland, the mortality risk of CHD in men was higher than in Sweden. Also the morbidity in CHD among Finnish immigrants in Sweden was higher than for Swedish men, but the morbidity decreased during the 1990s, to become lower than the morbidity of Swedish men (*Figure 12*).

In Poland, the mortality risk of CHD in men was higher than in Sweden. Also the morbidity in CHD among Polish immigrants in Sweden was higher than for Swedish men, and the morbidity decreased during the 1990s, to become at the same level as among the Swedish references (*Figure 12*).

In South Europe, the mortality risk of CHD in men was lower than in Sweden. The morbidity in CHD among South European immigrants in Sweden was at the same level as for Swedish men, but the morbidity increased during the 1990s, to become higher than among the Swedish references (*Figure 12*).

In Norway, the mortality risk of CHD in men was higher than in Sweden. The morbidity in CHD among Norwegian immigrants in Sweden was at the same level as for Swedish men, but the morbidity decreased during the 1990s, to become lower than among the Swedish references. In Germany, the mortality risk of CHD in men was lower than in Sweden. The morbidity in CHD among German immigrants in Sweden was at the same level as for Swedish men, but the morbidity decreased during the 1990s, to become lower than among the Swedish references (*Figure 12*).

In Poland, the mortality risk of CHD in men was higher than in Sweden. Also the morbidity in CHD among Polish immigrants in Sweden was higher than among Swedish men, but the morbidity decreased during the 1990s, to become at the same level as among the Swedish references. In Hungary, the mortality risk of CHD in men was higher than in Sweden. The morbidity in CHD among Eastern European immigrants in Sweden was higher than for Swedish men I 1991-93, but the morbidity decreased further during the 1990s, to become at the same level as among the Swedish references (*Figure 12*).

In Chile, the mortality risk of CHD in men was lower than in Sweden. Also the morbidity in CHD among Chilean immigrants in Sweden was lower than for Swedish men, but the morbidity increased during the 1990s, to become at the same level as among the Swedish references (*Figure 12*).

If we can assume that the mortality level is a reflection of the morbidity level of a specified disease, the mortality/morbidity seem to approach the level Swedes after

migration, e.g. is increasing coming from a low risk country and decreasing coming from a high risk country. In six out of the eight groups studied, the morbidity seemed to decrease during 1990s. It seems like the declining trend also exist among immigrant males in Sweden (*Figure 12*).

Immigrant women

The morbidity in CHD is increasing among Swedish women during the 1990s.

In Finland, the mortality risk of CHD in women was higher than in Sweden. Also the morbidity in CHD among Finnish immigrant women in Sweden was higher than for Swedish women, and the morbidity seemed to increase during the 1990s, to become even higher (*Figure 12*).

In Poland, the mortality risk of CHD in women was slightly higher than in Sweden. Also the morbidity in CHD among Polish immigrant women in Sweden was higher than for Swedish women, and the morbidity seemed to increase during the 1990s, to become even higher (*Figure 12*).

In South Europe, the mortality risk of CHD in women was lower than in Sweden. The morbidity in CHD among South European immigrant women in Sweden was at the same level as for Swedish women, but the morbidity seemed to increase during the 1990s (*Figure 12*).

In Norway, the mortality risk of CHD in women was higher than in Sweden. Also the morbidity in CHD among Norwegian immigrant women in Sweden was higher than for Swedish women, and the morbidity seemed to increase during the 1990s. In Germany, the mortality risk of CHD in women was at the same level as in Sweden. But the morbidity in CHD among German immigrant women in Sweden was higher than for Swedish women, and the morbidity seemed to increase during the 1990s (*Figure 12*).

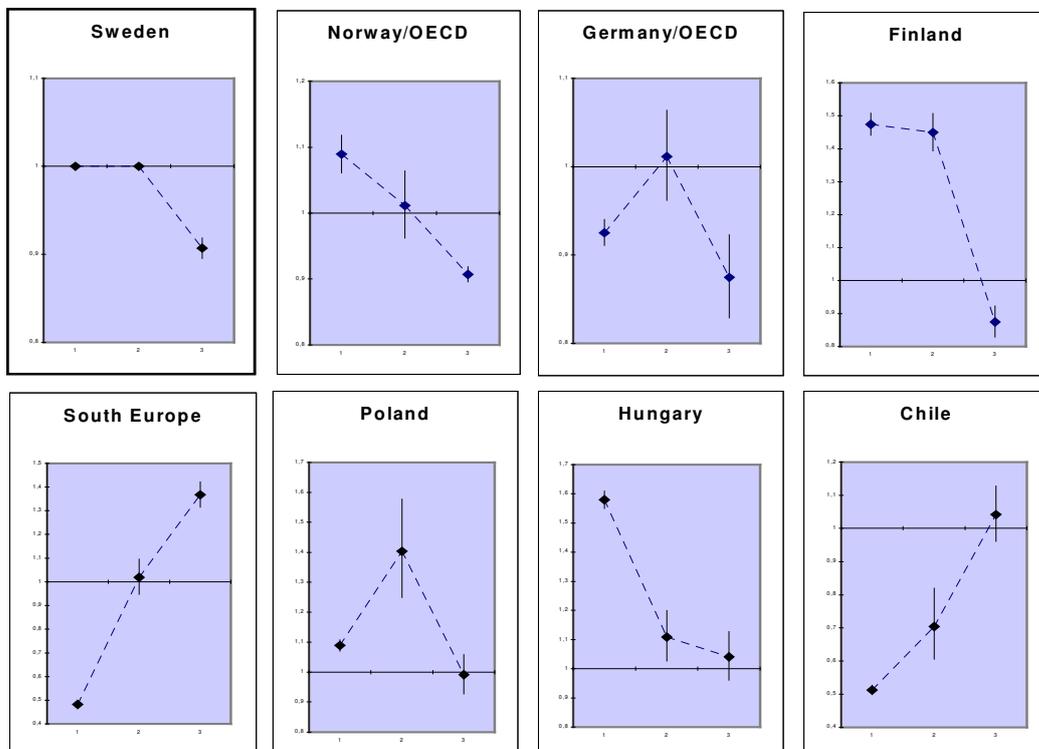
In Hungary, the mortality risk of CHD in women higher than in Sweden. The morbidity in CHD among Eastern European immigrant women in Sweden was at the same level as for Swedish women in 1991-93, but the morbidity seemed to increase during the 1990s, to become higher than among Swedish women (*Figure 12*).

In Chile, the mortality risk of CHD in women was lower than in Sweden. The morbidity in CHD among Chilean immigrant women in Sweden was at the same level as for Swedish women, and the morbidity kept at the same level during the 1990s (*Figure 12*).

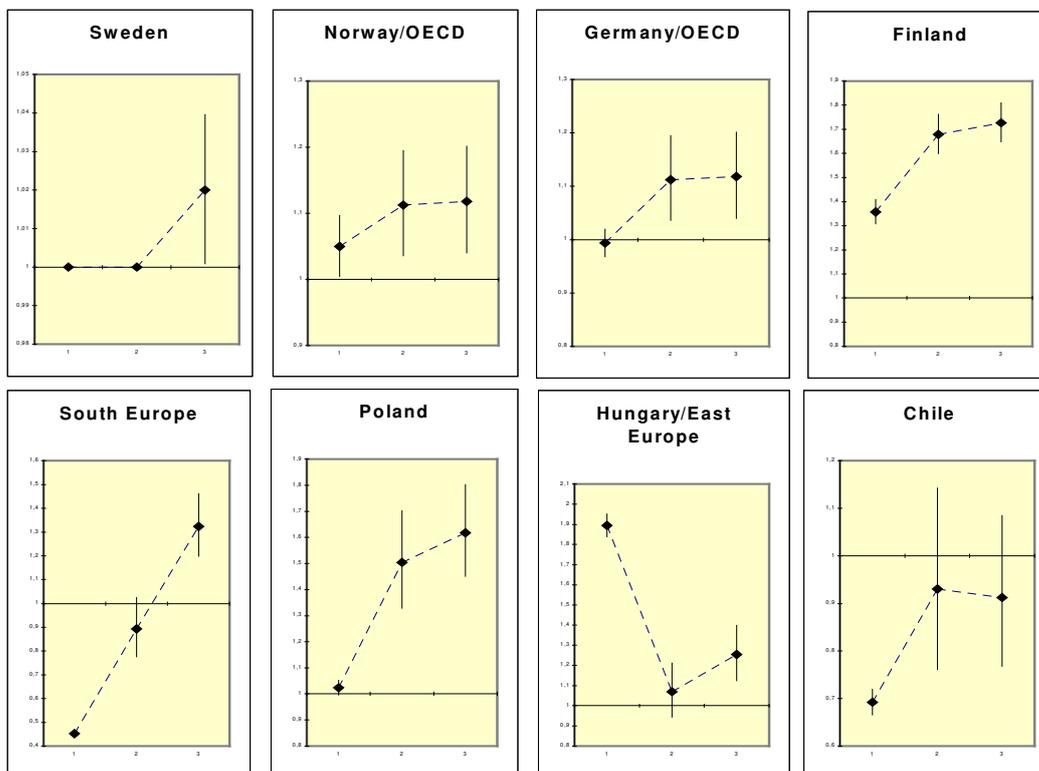
In seven out of the eight female immigrant groups studied, the morbidity seemed to increase during 1990s. It seems like there are no longer a declining trend, neither among Swedish nor among immigrant females in Sweden.

Figure 12 A comparison of the results from study 1-3. 1) the first dot illustrate the mortality risk of CHD in the country of origin compared to in Sweden, 2) the second dot the morbidity risk of CHD among immigrants in Sweden in 1991-93 compared to Swedish born references of the same sex in 1991-93, and 3) the third dot the morbidity risk of CHD in 1997-99 compared to the same references as for the second spot.

Men



Women



5 DISCUSSION

Morbidity and mortality in CHD varies a great deal between countries, and high or low risk countries for morbidity or mortality in CHD may be defined. The reasons for this are differences in risk factor distribution between countries, such as smoking; dietary factors; socio-economic factors e.g. influence of wealth or poverty, education or unemployment; psychological stress, e.g. by discrimination or persecution of dissidents, but also genetic inheritance of these diseases. The time trend of CHD has declined quickly in many countries, but large differences in mortality rates and trends were seen around the world, as in the developing countries where the mortality was rising fast. In Sweden, CHD mortality is, by international standards, high, but compared to industrialized countries, low. The all-cause mortality in Sweden is among the lowest in the world.

Immigrants in Sweden have increased risk of CHD compared to Swedish natives. The excess risks of CHD might be associated with increased risk of smoking among immigrant men and increased risk of obesity and physical inactivity among immigrant women. Despite the excess risks of CHD in Sweden, the all-cause and CHD mortality was even higher in the countries of birth. There was a sex difference in the time trend of CHD: the trend was decreasing in men and increasing in women.

The excess risk of CHD among immigrants in Sweden, associated with poorer risk profile, might be a remnant from the country of origin but might also be a sign that being an immigrant could be a risk on its own. Current migration is generally from the developing world towards the industrialized world. These immigrants are usually less educated than in the new country, which affects the CVD risk profile negatively [164]. However, when we adjusted for SES the risks remained high for most of the immigrant groups. Further, high frequency of smoking behavior might remain from the country of origin. Another risk of immigrants is that they are usually exposed to prejudices, which might affect the chance of getting a job, with high unemployment as a consequence. Further, the process of migration is associated with cultural, psychosocial and lifestyle changes in the new country which might lead to accentuated physical and psychological stress. High physical and psychological stress increase the risk of CHD. In addition, adaptation and integration into the new social and cultural environment may modify this risk.

If the excess risk is a remnant from the country of origin, through time it should decrease to approach the risk of the native Swedish population. This seems to be the case for more than half of the male immigrant groups, but, in contrast, for the majority of the female groups the risk increases. Thus, there is a difference between the sexes in the trend of CHD. The increased risk with time in Sweden can not be a remnant from the country of origin but rather an effect of life in the new country.

Among all groups of immigrant men the prevalence of smokers is increased compared to native Swedes, and among some groups of immigrant women the prevalence of obesity or physically inactive persons is higher than among Swedish women. Thus, there is also a difference between men and women in the risk factor profile of CHD. Might the difference in risk factor profile between sexes be associated with the differences in time trend of CHD?

The harmfulness of cigarette smoking became public knowledge during the 1960s and 1970s. By today, smoking has become drastically less common, as several measures have been taken by the authorities, e.g. prohibiting smoking in public institutions, and most recently in 2005, by prohibiting smoking in pubs and restaurants. The harmfulness of overweight, obesity, and physical inactivity has also been known for decades, but compared to smoking the public discussion arose 30–40

years later, and is going on today, e.g. in reports of decreasing physical activity and increasing obesity among children. Actions have continuously been taken by the authorities to increase physical activity and decrease the prevalence of obesity.

From a risk factor perspective, high or low risk countries can also be defined in terms of risk factors, e.g. high or low risk of smoking, physical inactivity, unhealthy diet, obesity, psycho-social or physical risk factors. For example, Sweden is a low-risk country for smoking but a high-risk country for hypertension and hyperlipidemia. When men from the Middle East, where smoking is frequent among men but not among women, migrate to Sweden, where smoking is less common, the smoking behaviour can be expected to decrease. But for immigrant women from the Middle East, the contrary can be expected, e.g. smoking behaviour can increase. The cost of fruit and vegetables compared to meat and milk products on the Swedish market is relatively high, by international standards. Sweden might be seen as a high-risk country for unhealthy diet. Therefore, after migrating to Sweden, switching from a diet based on fruit and vegetables to a diet based on meat and milk products, there is an obvious risk of worsened dietary habits. The higher prevalence of obesity among immigrant women might be related to deteriorated dietary habits caused by migration, but climate changes leading to decreasing physical activity might also have an effect.

The majority of immigrant men originated from countries with higher risks of CHD than in Sweden, e.g. Finland and Hungary, and the risks seem to decrease after migration. But when people come from countries with lower risks of CHD than in Sweden, e.g. Southern Europe, the risks seemed to increase after migration. After a while living in Sweden, the risk tended towards the low risk level of Swedish men. This trend might be explained by decreasing smoking behaviour. Like immigrant men, the majority of immigrant women presented a high risk of CHD in the country of origin, which either decreased or remained unchanged after migration, but in contrary to men, the risk of CHD tended to increase through time. Migration from countries with dietary traditions based on fruit and vegetables and a physically active life, low-risk countries, to a country with less favorable dietary traditions and physical activity behavior, a high-risk country, there is an obvious risk of deterioration of these risk factors, and secondly, through time, increased risk of CHD. But why does the risk among women improve just after the migration, but deteriorate after some time in Sweden? Other risk factors, unknown today and not analyzed in this project, might also have had an influence on the trend in women.

We expected to see increased risks of CHD among immigrants in Sweden compared to the country of origin, based on the fact that immigrants are exposed to cultural, psychosocial, and lifestyle changes, often leading to increased physical and psychological stress. But this is not the case for the majority of immigrant groups studied. The change in risk of CHD by migration was rather associated with the risk of the country of origin and with the risk of the new country, ending up in between these two risk levels. It seemed as if the power of urging social and societal acceptance by acculturation and assimilation, to adopt the lifestyle of the new country, might conceal a possibly increased risk as a result of increased physical and psychological stress. The healthy migrant effect might also affect the risk, making it lower among immigrants in Sweden than in the country of origin. But with acculturation to the risk level of the new country, the risk trend should also be adopted through time. This is the case for the majority of male immigrant groups studied, but not for the majority of the female immigrant groups, where the risk was increasing. Thus, there is a difference between the sexes among the immigrant groups studied, first in trend of CHD, decreasing for men, increasing for women; secondly, adopting the trend of the native population: immigrant men adopt the trend, immigrant women do not. As regards the time trend for immigrant women, it seems

as if our initial assumption is confirmed. But why do morbidity and mortality among immigrant women improve just after migration but deteriorate through time? Why do immigrant females not adopt the trend of Swedish females? Might our assumption be true, that immigrant women, more than immigrant men, after some time in Sweden are exposed to cultural, psychosocial, and lifestyle changes that lead to increased physical and psychological stress with a considerable influence on morbidity and mortality in CHD?

5.1 LIMITATIONS AND STRENGTHS

5.1.1 Limitations

The studies in this project are based on data from existing databases—MigMed, WHO, and SALLS—and, as a consequence, we were restricted to these data. No data on lifestyle and risk factors were available either in the WHO or in the MigMed database but only in the SALLS. Further, no socio-economic variables are available in the WHO database, nor information about the length of stay in Sweden from the MigMed database.

Only the largest immigrant groups in Sweden could be included, those with outcomes large enough to yield reliable estimates. By merging small immigrant groups into larger regional groups, or by expanding the study periods, we increased the number of immigrant groups that could be included. But there are problems in regional grouping of countries when the group comprises rather different countries. The specificity of each country gets lost and positive or negative effects might be diluted. Dilution into the group loses the characteristics of a single country, e.g. cultural, ethnical, political and religious characteristics.

We also used the method to aggregate data, to yield reliable estimates. But there might be problems related to use aggregate data. E.g. same individuals are included in several study periods. Extreme subpopulations or outcomes of the period, or absence of important subpopulations, might amplify or dilute the effect and have an unproportional high influence at the results.

Comparing data from two different databases is well known to be associated with methodological problems, e.g. differences in the procedure of collecting data, in clinical traditions, in rules, routines, and in administration procedures, making the reliability of data and diagnoses differ. The statistical and mortality data from WHO are produced by each individual country reporting national data to the WHO. The information in the WHO database might be biased due to differences between countries. In this sense, the outcome “total mortality” is ideal since diagnosing a death is probably alike worldwide. Therefore, the data on total mortality are reliable. CHD is well-defined according to ICD, but in practice, diagnosing CHD is probably associated with misclassifications. Completeness and coverage are two ways of estimating the reliability of the WHO data. In some countries, the vital registration data system covers only a part of the country, for example urban areas (coverage). In some other countries, although the vital registration data system covers the whole country, not all deaths are registered (completeness). WHO has made validations of the completeness and coverage of these data. According to these validations, the completeness and coverage are acceptable for the countries included in this study (completeness estimated at 100% in all groups, and coverage calculated by dividing

the total deaths reported for a country-year from the vital registration system by the total deaths estimated by WHO, at 92–108%).

One of the main databases included in MigMed is the Registry of the Total Population (RTP). Most studies of the reliability of the RTP have found satisfactory results. One reliability problem concerns overcoverage as a consequence of re-emigration, since this is not always reported to the authority, and consequently RTP might include more people than they are meant to cover. These re-emigrated people become immortal in Swedish statistics. But the low mortality among Swedish immigrants compared to the country of birth is not explained by over-coverage alone. Also the healthy migrant effect might have an influence on the relatively low mortality rates among immigrants. Estimates of how large the over-coverage in the registers is have been made, e.g. by investigating the proportion of returned mail, the non-response rate in surveys, studies of people who lack a recorded income, differences in mortality between immigrants and the native population. The over-coverage has been estimated at 0.1% in the total population, 1.0% for Scandinavian citizens and 2.8% in the whole foreign group, or as high as 10% [165]. In another estimation the over-coverage was estimated to be greatest for the middle-aged (35–64), non-married, urban immigrants from outside Europe, or 4–8% of the immigrant population [166].

Another database included in MigMed is the In-Care-Register. As many disorders included in the CVD group (acute rheumatic fever, chronic rheumatic diseases, CHD, hypertension, ischemic heart diseases, diseases of the pulmonary circulation, other cardiac diseases, cerebro-vascular diseases, diseases of the arteries, arterioles or capillaries, vascular diseases in venous and lymphatic systems or in lymph nodes, diseases of the circulatory system not specified elsewhere) are often investigated, diagnosed, and treated in primary health care, the incidence rate of CVD morbidity might be underestimated. Further, cases of CVD and CHD might have been missed because the subjects died before they were admitted to hospital or, in the case of immigrants, died or were treated abroad. As regards CHD, most of the subjects are probably treated at hospitals, at least for cardiac infarction and severe angina pectoris, and thereby included in the In-care Register. Further, it has been shown that the validity of the ICD code for CHD is very high [167]. Regarding CHD, the validity of data is probably much higher than for CVD. The under-reporting of admissions is estimated at less than 1%. Administrative failures are estimated at 1–3%. In another test of validity of the diagnoses [159], a total 86% of the reported diagnoses fulfilled the defined criteria. A majority of the patients who did not fulfill the criteria were diagnosed as possible cardiac infarctions. The amount of false positive reports that did not fulfill the diagnostic criteria was estimated at 5%. The false negative reports were estimated at less than 3%, in accordance with earlier studies on this subject [167-173]. Differences between regions and between internal medicine departments with or without cardiac intensive care were also seen in some cases [159, 171].

In general, negative self-reported conditions tend to be under-reported. The SALLS data are based on self-reports. Whether or not foreign-born and Swedish-born people have biases in reporting smoking, weight, height, physical inactivity, hypertension and diabetes is unclear, given that these concepts may be understood differently in different cultural groups [174]. Self-reported data tend to be closer to the mean or the “desirable” values [175], e.g. weight and height in this study, or a “slim body shape” [127, 135, 162]. There are several studies on the bias regarding self-reported conditions, such as obesity [176], diabetes mellitus and underestimation of socio-economic inequalities Mackenbach, 1996 #2056}. However, self-reports yield an acceptable estimate of the prevalence of hypertension, diabetes, and physical activity [177-180]. Finally, the dichotomization of the questions in this survey, e.g.

those about smoking, into yes or no is a rough classification of smokers that may include both moderate and heavy smokers and different types of tobacco, which simplifies the true picture of risk-factor distribution.

Acculturation into a new country and culture has an influence at health by a change of life-style and risk factors of disease. The acculturation increases by time. Therefore, the all-cause and CHD mortality among immigrants should, by time, approach the Swedish level, and recede from the level in the country of birth. Although not having individual data on time living in Sweden, we have to handle aggregated data, and have accessible historical information about the peak period of immigration. Therefore, differences in risk might reflect different levels of acculturation into the Swedish culture according to time that the immigrant have lived in Sweden.

5.1.2 Strengths

The limitations of this study are balanced by its strengths. The data in SALLS were collected in face-to-face interviews by well-trained interviewers. The quality of the variables has been studied in re-interviews and is mostly high [181]. The completion rate of the material has been as high as 98% and higher, except for education among older immigrants. This is a minor problem as the immigrants are generally young.

Using the ten-digit personal identification number, assigned to each person, including refugees and immigrants, staying more than 12 months in Sweden, made it possible to link information from several different registers, as is done in MigMed. Many of the registers include the whole population. This has enabled us to study a very large sample size, based on the total population of approximately nine million persons, varying in size according to the age span we chose to study. These circumstances have made it possible for us to study a very large and geographically unrestricted sample size, including both sexes, in twelve different immigrant groups and taking age, SES, and gender into consideration. All this information combined in a single study is the very unique strength of this project.

5.2 CONCLUSIONS AND RECOMMENDATIONS

Immigrants in Sweden have increased risk of CHD compared to Swedish natives. The excess risks of CHD, according to results of this project, might be associated with increased risk of smoking among immigrant men and increased risk of obesity and physical inactivity among immigrant women, remnant risk behavior from the country of origin, but might also be a sign that being an immigrant could be a risk of its own because of stress from migration and acculturation. Despite the excess risks of CHD among immigrants in Sweden, the all-cause and CHD mortality was even higher in the countries of birth. It seems as if, in contrast to what we expected, the risks generally decrease with migration, towards the lower level of native Swedes. The time trend of morbidity in CHD decreased for more than half of the male immigrant groups, but, in contrast, for the majority of the female groups the risk increased, diverging from the risk trend of Swedish women. The differences between the sexes might be explained by different distribution of risk factors, and differences in the time trend of the risk factors. Yet it might also be explained by physical and psychological stress. Acculturation and assimilation into Swedish society, e.g. adopting a “Swedish lifestyle,” might be easier for immigrant men than for immigrant women. Is the

emancipated life of Swedish women difficult to combine with a traditional private role as housewife, causing a social conflict and secondary increased physical and psychological stress? In conclusion, it is important to focus on immigrants, and particularly immigrant women, in the prevention of CHD, as they are risk groups for CHD.

6 SAMMANFATTNING PÅ SVENSKA

6.1.1 Introduktion

Hjärt-kärlsjukdom (CVD) och ischemisk hjärtsjukdom (CHD) är den vanligaste orsaken till död och sjukdom i den industrialiserade världen. Sedan mitten av 1900-talet har den totala sjukligheten och dödligheten i befolkningen, liksom sjukligheten och dödligheten i CVD och CHD, minskat. I vissa minoritetsgrupper har dock sjukligheten och dödligheten ökat, exempelvis bland invandrarna. Invandringen till Sverige har ökat sedan 1900-talets början och idag utgör invandrarna ca 12 % av den svenska befolkningen.

Individens hälsa påverkas av den nedärvda förekomsten för sjukdom, av levnadsvanor exempelvis rökning, kostvanor och fysisk aktivitet, och av socioekonomiska faktorer, exempelvis utbildningsnivå, arbetslöshet och social status. Invandrare kan vara eller ofta uppleva sig vara utsatta för diskriminering och fördomsfull behandling vilket påverkar hälsan negativt. Av denna anledning antog vi att tillvaron som invandrare utgör en riskfaktor för ohälsa.

Det finns många studier som handlar om invandrare och hälsa men som uppvisar motsägelsefulla resultat. I många av studierna beskriver man en försämrad hälsa bland invandrare, men i andra en förbättrad hälsa. I de flesta studier som handlar om invandrare och hälsa har man dock studerat begränsade populationer, t.ex. enskilda invandrargrupper, små upptagningsområden eller enbart män, eller inte tagit hänsyn till socioekonomiska faktorer. Vidare är det okänt hur hälsan bland invandrare förändras med tiden i det nya landet. Därför var syftet med detta projekt att uppskatta risken för CVD/CHD, inklusive utvecklingen över tid, och förekomsten av riskfaktorer för CVD och ischemisk hjärtsjukdom (CHD) bland invandrare i Sverige jämfört med infödda svenskar, samt att undersöka eventuella skillnader mellan invandrare i Sverige och befolkningen i ursprungslandet. Dessutom ville vi i analysen justera materialet för ålder och socioekonomiska faktorer (SEF).

6.1.2 Frågeställningar

Syftet med den första studien var att bedöma invandrades sjuklighet i hjärt-kärlsjukdomar i förhållande till den svenska befolkningen. Syftet med den andra studien var att jämföra dödligheten bland invandrare i Sverige med dödligheten i deras ursprungsländer. Syftet med den tredje studien var att beskriva förändringen av kardiovaskulär sjuklighet över tiden, och se om en sjunkande trend även existerar bland invandrare. Syftet med den fjärde studien var att beskriva förekomsten av kardiovaskulära riskfaktorer och riskbeteenden bland invandrare jämfört med svenskar.

6.1.3 Material och metod

Den första studien, om förekomst och relativa risker för CVD och CHD i olika invandrargrupper, är en uppföljningsstudie utförd mellan 1 januari 1997 och 31 december 1998, utgående från hela den svenska befolkningen. Tre och en halv miljon

personer i åldrarna 35–64 år, varutav 550 000 utlandsfödda, inkluderades. Materialet analyserades m.h.t. indirekt standardisering och Cox PH Regression Model och presenteras som incidenstal och "hazard ratios" (relativa risker).

Den andra studien, om dödligheten (total och CHD) bland åtta invandrargrupper i Sverige samt i deras ursprungsländer, är en uppföljningsstudie på två oberoende kohorter, invandrare i Sverige baserad på databasen MigMed och befolkningen i ursprungsländerna baserad på WHO-data. De svenska invandrarna är studerade mellan 1 januari 1991 och 31 december 1998. Till invandrargrupperna motsvarande total befolkning från ursprungslandet är studerad mellan 1 januari 1995 och 31 december 1995. Materialet analyserades m.h.t. indirekt standardisering och Poissons regressionsmodell och presenteras som åldersjusterade incidenstal och oddskvoter.

Den tredje studien, en uppföljningsstudie av förändringar i CVD/CHD sjuklighet under 1990-talet bland tolv invandrargrupper i Sverige, är baserad på två oberoende kohorter, den första mellan 1991–93 (referens) och den andra mellan 1997–99. Hela den svenska befolkningen i åldrarna 35 till 74 inkluderades. Materialet analyserades m.h.t. indirekt standardisering och Poissons regressionsmodell och presenteras som åldersjusterade incidenstal och oddskvoter.

Den fjärde studien, en tvärsnittsstudie på riskfaktorer för CHD bland åtta invandrargrupper i Sverige samt en svenskfödd referensgrupp, baseras på data från 1 januari 1996 till 31 december 2002. Ett stickprov av totalbefolkningen i åldrarna 27 till 60 år studerades. Materialet analyserades m.h.t. en log-binomial-modell och presenteras som prevalenskvoter.

6.1.4 Resultat

I den första studien var den åldersjusterade risken för CHD förhöjd i de flesta invandrargrupper jämfört med svenskar. I tio av tolv manliga invandrargrupper och i elva av tolv kvinnliga grupper var risken förhöjd jämfört med svenskarna. I två manliga invandrargrupper och en kvinnlig invandrargrupp var risken sänkt jämfört med svenskarna. Då man även justerade för utbildningsnivå och arbetslöshet var risken fortsatt förhöjd, men generellt på en lägre nivå.

I den andra studien var total mortaliteten lägre i alla manliga invandrargrupper jämfört med i ursprungslandet. För finska invandrarkvinnor i Sverige var risken lätt förhöjd. Mortaliteten i CHD var lägre bland sex av åtta manliga invandrargrupper och bland fem av åtta kvinnliga invandrargrupper jämfört med i ursprungslandet. I två grupper av manliga invandrare och tre grupper av kvinnliga invandrare var risken för CHD högre än i ursprungslandet.

I den tredje studien var den åldersjusterade trenden sjunkande i sex av elva manliga, och stigande i tio av elva kvinnliga invandrargrupper. För tre av elva manliga invandrargrupper var trenden stigande. Trenden var oförändrad i en av de manliga, och i en av de kvinnliga invandrargrupperna.

I den fjärde studien kunde vi beskriva en ökad förekomst av rökning i alla grupper av invandarmän, och i två av åtta grupper av invandrarkvinnor. Bland iranska kvinnor var rökning mindre vanligt än bland svenska kvinnor. Vidare fann vi en ökad förekomst av fysisk inaktivitet i fem av åtta grupper av invandarmän och i sex av åtta grupper av invandrarkvinnor. I resterande grupper var den fysiska aktiviteten på samma nivå som bland svenskarna. Slutligen fann vi en ökad förekomst av fetma i en av åtta grupper av invandarmän, och i tre av åtta grupper av invandrarkvinnor. I resterande grupper var förekomsten av fetma på samma nivå som bland svenskarna.

6.1.5 Slutsatser

Invandrare uppvisar en överrisk för CHD jämfört med svenskfödda, även efter justering för utbildningsnivå och arbetslöshet. Trots detta var totalmortaliteten och CHD-mortaliteten i majoriteten av invandrargrupperna lägre bland svenska invandrare än i ursprungslandet. Då invandraren kommer från ett högriskland med avseende på CHD, såsom ex Finland och Ungern, verkar risken att sjunka efter migration, och då invandraren kommer från ett lågriskland med avseende på CHD, såsom från Sydeuropa, verkar risken öka.

De flesta invandrargrupper uppvisar en överrisk för CHD i förhållande till infödda svenskar. Denna överrisk, med en sämre riskfaktorprofil, skulle kunna vara en kvarleva från invandrarens ursprungsland, men kan också vara en indikator på att invandrarstatus är en risk i sig. Om den ökade risken är en kvarleva från ursprungslandet borde överrisken med tiden i Sverige försvinna, och alltmer närma sig den svenska referenspopulationens risknivå. Detta sker under 1990-talet bland drygt hälften av de manliga invandrargrupperna, men tvärt emot förväntat sker en ökning bland en majoritet av de kvinnliga invandrargrupperna. Det finns alltså en tidsberoende könsskillnad mellan män och kvinnor för sjuklighet och dödlighet i CHD.

Förekomsten av rökare är mycket högre bland invandarmän jämfört med svenskar. Invandrankvinnor är mindre fysiskt aktiva och mer överviktiga än svenska kvinnor. Det finns således även här en könsskillnad, i detta fall gällande riskfaktorprofil mellan kvinnor och män. Kan könsskillnaderna i riskfaktorprofilen ha ett samband med den tidsberoende skillnaden i trendutveckling av sjuklighet och dödlighet i CHD?

Rökningens skadeverkningar blev allmänt kända under 1960- och 1970-talen. Idag har vi ett samhälle där rökningen kraftfullt har minskat, och där man idag på allmänna platser betydligt försvårat möjligheten för att röka. Även skadeverkningarna av övervikt, fetma och fysisk inaktivitet har länge varit kända, men den publika uppmärksamheten har jämfört med rökningen kommit 30–40 år senare, och är idag högst aktuell som ett hälsoproblem, med bl.a. rapporter om minskad fysisk aktivitet och ökande vikt bland ungdomar och barn. Åtgärder i syfte att minska dessa hälsoproblem genomförs kontinuerligt, exempelvis genom att efter år av nedprioritering åter öka mängden fysisk aktivitet i skolorna.

Risken för sjuklighet och dödlighet varierar mycket mellan olika länder, och hög- och lågriskländer kan definieras. Men med ett riskfaktorperspektiv kan hög- och lågriskländer för hälsa definieras med avseende på t.ex. rökning, fysisk aktivitet, kosthållning och fetma, psykosocial och fysisk miljö. Sverige är idag exempelvis internationellt sett ett lågriskland för rökning, men ett högriskland för hypertoni och hyperlipidemi. Om man exempelvis kommer som invandrarman från Mellanöstern, där rökning är vanligt bland män men inte bland kvinnor, till Sverige med låg förekomst av rökare, borde detta påverkas i en hälsobefrämjande riktning med avseende på rökning. För invandrankvinnan från Mellanöstern borde däremot effekten kunna bli den motsatta. Med avseende på kost, med Sverige som högriskland och länderna i Mellanöstern som lågriskländer, kan däremot effekten för bägge könen bli negativ för hälsan.

En majoritet av de manliga invandrargrupperna vi studerade uppvisade i sitt ursprungsland en hög risk för CHD, som antingen sjönk eller kvarstod som oförändrad efter migration till Sverige. Med tiden i Sverige närmade sig risken den låga nivån hos svenska män. Denna utveckling kan delvis förklaras av minskad rökning. Även bland majoriteten av de kvinnliga invandrargrupperna fanns liksom hos männen en hög risk för CHD i sitt ursprungsland, men den sjönk eller kvarstod

oförändrad efter migration till Sverige. I motsats till männen uppvisade dock kvinnorna, både absolut och i relation till de svenska kvinnorna, en stigande sjuklighet i CHD med tiden. Migrationen till Sverige från ett lågriskland med avseende på kost och motion, till ett högiskland, riskerar att försämra invandrarkvinnans kost- och motionsvanor med tiden, och därmed öka sjukligheten i CHD. Andra faktorer, som inte analyserats i detta projekt, kan dock också bidra, och av denna anledning behövs fler studier på detta område. Det är dock redan idag viktigt att primärvården uppmärksammar invandrare, och i synnerhet den invandrande kvinnan, som en riskgrupp avseende försämrade fysisk och psykisk hälsa med bl.a. ökad sjuklighet i CHD.

6.1.6 Fortsatt planering

Både invandarmän och -kvinnor uppvisar en förhöjd risk att insjukna i CHD. Invandarmännen tenderar att med tiden närma sig nivån för den svenske mannen. Till skillnad från männen uppvisade dock kvinnorna, både absolut och i relation till de svenska kvinnorna, en ökad sjuklighet i CHD med tiden. Vad är orsaken till den initiala förbättringen efter migrationen, men en efterföljande försämring med tiden i Sverige? Kan denna utveckling enbart förklaras av försämrade kost- och motionsvanor efter ankomsten till Sverige? Kan möjligen andra, mer svårdefinierade faktorer, förklara denna utveckling bland kvinnorna? Kan dagens svenska samhälle och sociala system, både för den svenska, men framförallt för den invandrande kvinnan, vara negativ för hälsan?

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