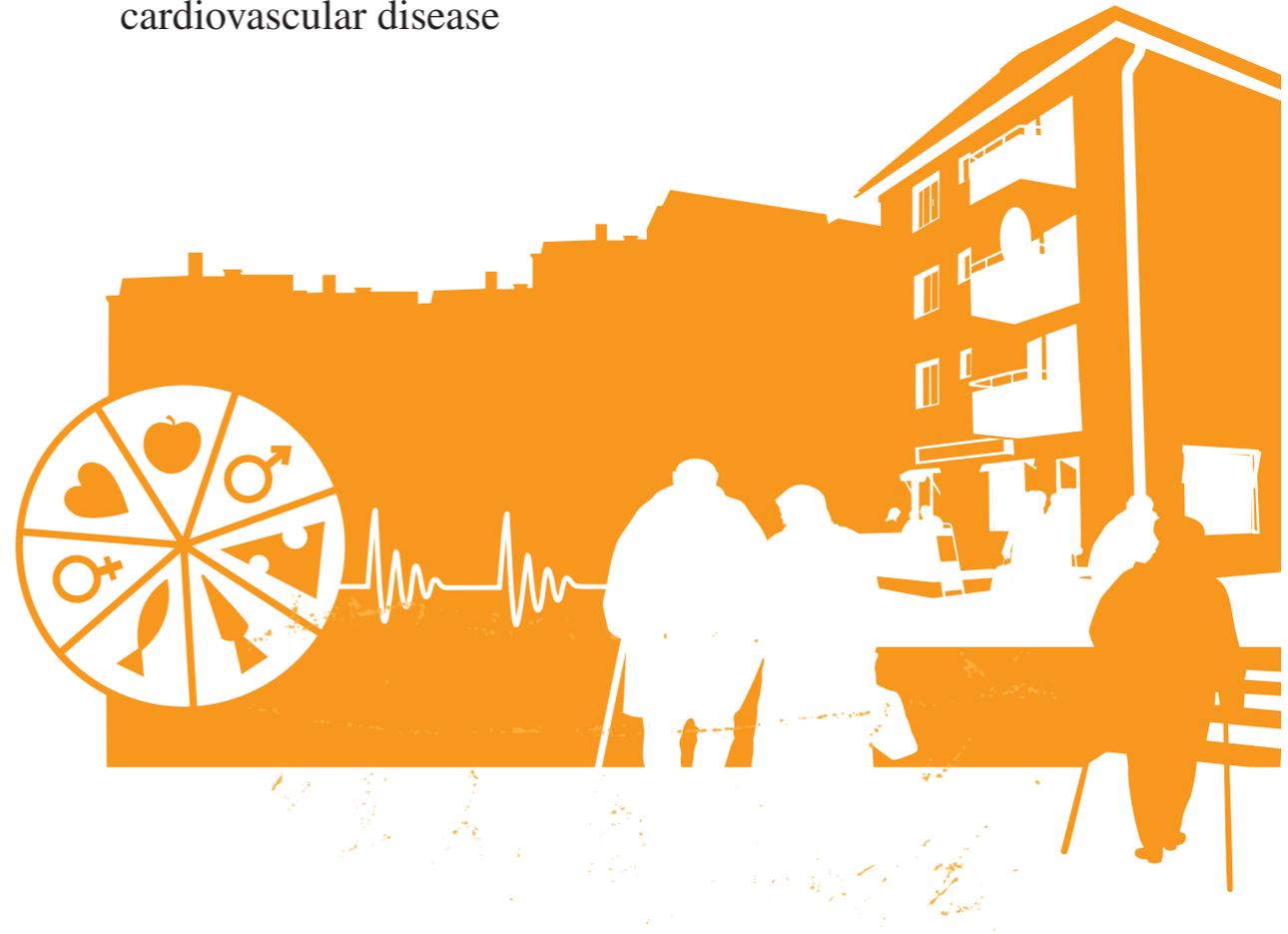


Thesis for doctoral degree (Ph.D.)
2008

ELDERLY IRANIANS IN SWEDEN

The impact of migration on risk factors for
cardiovascular disease



Afsaneh Koochek

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ABSTRACT

Aim: To analyze determinants of and differences in risk factors for cardiovascular disease (CVD) among elderly Iranians in Sweden, elderly Swedes, and elderly Iranians in Iran.

Method: A total of 1212 men and women aged 60–84 were studied. *Study I* included 167 Iranian-born and 235 Swedish-born residing in Stockholm, Sweden. The outcome variables, body mass index (BMI) and self-reported leisure-time physical activity were analyzed by linear regression and unconditional logistic regression. *Study II* included 176 Iranians in Stockholm and 300 Iranians in Tehran and was designed to determine the prevalence of general obesity, abdominal obesity, hypertension, smoking, and diabetes. Unconditional logistic regression was used to estimate odds ratios (ORs) with 95% confidence intervals (CIs) for outcome variables. In *Study III*, the Short Form Health Survey (SF-36) was administered to collect information about health-related quality of life in elderly Iranians in Sweden (n=176), elderly Iranians in Iran (n=298), and an elderly Swedish control group (n = 151) randomly selected from the general population. Multiple linear regression procedures were applied to analyze data while adjusting for age and education. In *Study IV*, dietary intakes were assessed by administering a semi-quantitative food frequency questionnaire to 121 Iranians living in Stockholm and 52 Iranians living in Tehran. Differences in dietary habits between the two groups and association of dietary habits with prevalence of overweight, general obesity, and central obesity were analyzed by linear and unconditional logistic regression.

Results: In *Study I*, Iranian women had the highest mean BMI (29.2) of all subgroups. The model that included an interaction between sex and length of time in Sweden showed that there was no significant difference in BMI between Swedish men (reference group) and Swedish women or Iranian men. In contrast, Iranian women had significantly higher average BMI than the reference group after adjustment for age, education, and marital status. The largest difference in BMI compared to the reference group was found among Iranian women who immigrated to Sweden in 1989 or later. Iranians and Swedes had almost the same odds of \geq once-weekly leisure-time physical activity. In *Study II*, the risks of hypertension and smoking were higher in Iranian women and men in Sweden than in Iran in the age-adjusted model and remained significant after adjusting for all other independent variables. Abdominal obesity was found in nearly 80% of the women in both groups. In *Study III*, Iranian women in Sweden with shorter times of residence scored lower vitality than other women in this study. Among elderly Iranian women, more than 15 years of residence in Sweden was positively associated with social functioning and role limitation due to emotional problems.

In general, the Swedish women scored higher in all dimensions of the SF-36 than the women in the other two subsamples. The Swedish men scored higher in six of eight dimensions than the men in the other two subsamples. *Study IV*, Iranians living in Sweden consumed more protein, total fat, fiber, and all food groups than Iranians living in Iran, with the exception of bread and grain. The only association found between diet and prevalence of overweight, general obesity, and central obesity was an inverse association between fruit consumption and central obesity in Iranians who had lived in Sweden >15 years.

Conclusions: There is a strong association between migration status and the prevalence of cardiovascular disease among elderly Iranians living in Sweden. However, length of time since migration to Sweden is not associated with poorer health-related quality of life among elderly Iranians. In fact, the partial adoption of favorable dietary habits may be associated with increasing number of years in Sweden. The adoption of such favorable habits may lead to increased health-related quality of life, decreased CVD risk factors, and increased life expectancy. Health promotion in the public health care system and interventions aimed at the prevention and treatment of overweight and obesity should include a special focus on recent elderly female immigrants, who exhibited the largest difference in BMI and lowest score of health-related quality of life compared to the reference groups. Such resources could empower individuals to achieve a lifestyle that includes more physical activity and healthier dietary habits. This could increase health-related quality of life and decrease risk of obesity and CVD, especially as regular physical activity clearly attenuates many of the health risks associated with overweight or obesity. Treatments and prevention programs that focus on lifestyle changes, carried out by dietitians, physiotherapists, district nurses and physicians in primary health care are therefore recommended.

Keywords: acculturation, aged, cardiovascular disease, diet survey, emigration and immigration, ethnicity, health-related quality of life, Iran, lifestyle, nutrition; obesity, risk factors, Sweden.

*Whoever travels without a guide needs two hundred
years for a two-day journey.*

Jalal al-Din Rumi (1207–1273)

To my parents:

Dr. Ahmad Koochek Shoushtari and Sima Moezi

You were, are, and will be my guides forever

LIST OF PUBLICATIONS

- I A Koochek, S-E Johansson, TO Kocturk, J Sundquist and K Sundquist. Physical activity and body mass index in elderly Iranians in Sweden: a population-based study. *European Journal of Clinical Nutrition* 2007. July 25
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- III Afsaneh Koochek, Ali Montazeri , Sven-Erik Johansson, Jan Sundquist. Health-related quality of life and migration: A cross-sectional study on elderly Iranians in Sweden. *Health and Quality of Life Outcomes* 2007, 5:60.
- IV Afsaneh Koochek, Parvin Mirmiran, Kristina Sundquist, Tohid Azizi, Ali S. Moeini, Navid Saadat, Sven-Erik Johansson, Brita Karlström, Fereidoun Azizi, Jan Sundquist. Dietary differences between elderly Iranians living in Sweden and Iran. A cross-sectional comparative study. Submitted.

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LIST OF ABBREVIATIONS

ADA	American Dietetic Association
BMI	Body mass index
BMR _{rest}	estimated basal metabolic rate
CHD	Coronary heart disease
CI	Confidence interval
CV	Coefficient of variation
CVD	Cardiovascular disease
DBP	Diastolic blood pressure
DM	Diabetes mellitus
EI _{rep}	Reported energy intake
EU	European Union
FFQ	Food Frequency Questionnaire
FPG	Fasting plasma glucose
HRQL	Health-related quality of life
IFG	Impaired fasting glucose
IOM	International Organization of Migration
NFA	National Food Administration
OGTT	Oral glucose tolerance test
OR	Odds ratio
PAL	Physical activity level
SALLS	Swedish Annual Level of Living Survey
SD	Standard deviation
SES	Socioeconomic status
SBP	Systolic blood pressure
TLGS	Tehran Lipid and Glucose Study
WHO	World Health Organization

CONTENTS

Introduction	7
Aging.....	7
Aging in Iran	7
Aging in Sweden	8
Migration.....	9
Worldwide.....	9
The concept of migration and immigration in Iran	9
The concept of migration and immigration in Sweden	9
Cardiovascular disease and migration.....	10
Definition of cardiovascular disease	10
Risk factors for cardiovascular disease among elderly people	11
Cardiovascular disease and health-related quality of life.....	17
Theoretical model of the impact of migration on health-related quality of life and cardiovascular risk factors	18
Aims	21
General aims.....	21
Specific aims	21
Study I.....	21
Study II.....	21
Study III	21
Study IV	21
Materials and methods	22
Main data sources.....	22
Elderly Iranians in Stockholm.....	22
The Swedish Survey of Living Conditions (SALLS).....	27
Tehran Lipid and Glucose Study (TLGS).....	27
Swedish SF-36 national normative database	28
Iranian SF-36 national normative database (Iranian S-F36).....	28
Methods.....	28
Outcome variables.....	30
Explanatory variables.....	31
Statistical analysis	31
Ethical Considerations	33
Main Results.....	34
Study I.....	34
Hypothesis.....	34
Results.....	34
Conclusion	36
Study II.....	36
Hypothesis.....	36
Results.....	37
Conclusion	39
Study III.....	39
Hypothesis.....	39
Results.....	39

Conclusion.....	41
Study IV.....	41
Hypothesis.....	41
Results.....	41
Conclusion.....	44
Discussion.....	45
Main findings.....	45
Comparison with other studies.....	45
Possible Pathways between Migration and CVD Risk Factors.....	47
Changes in lifestyle.....	47
Nutritional transition.....	47
Selective migration.....	48
Socioeconomic status.....	48
Acculturation.....	48
Limitations and strengths.....	48
Conclusion and implication.....	51
Summary in Swedish.....	52
Acknowledgements.....	54
References.....	56
Study I.....	69
Study II.....	77
Study III.....	83
Study IV.....	91

INTRODUCTION

AGING

It is not simple to define terms pertaining to aging adults, such as *elderly people* or *old age*, since there is no universally accepted age or age range that corresponds to the terms. The definition of elderly people is not simple, since there is no standard numerical criterion. Instead, aging is a multifactorial concept involving cultural, biological, and social aspects, which in turn create different definitions across different parts of the world. In the studies in this thesis, the lower cut-off point for age among participants was set at 60 years for several reasons. First, 60 years is an age at which some people begin to retire in Sweden, particularly immigrants. Second, 60 years is the most usual retirement age in Iran, as in many countries the age of retirement is often equated with the beginning of old age. The World Health Organization's (WHO) definition of old age says that "The United Nations has not adopted a standard criterion, but generally uses 60+ years to refer to the older population" [1]. In light of both longer life expectancy and declining fertility rates, the aging population in many developed and developing countries is growing faster than the whole population. WHO predicts that the population age 60 or over will double from 600 million in 2000 to nearly 1.2 billion by the year 2025 [2].

Aging has consequences on the cellular, individual, and societal levels. On the cellular level, aging is associated with multiple physiological, intracellular, and metabolic changes which may increase vulnerability to chronic disorders such as cardiovascular disease (CVD), mental disorders, and cancer, the most common long-term diseases among those aged 60 and over. Being old and being a member of an immigrant or minority racial/ethnic group is associated with an increased risk of medical treatment for a wide variety of conditions [3-6]. Thus, elderly immigrants, especially women, seem to have many burdens that influence their health, such as ethnic minority status, age, sex, and lower socioeconomic status (SES). This is a serious issue for society because the proportion of elderly people, including elderly immigrants, many of whom also have low SES, is increasing in most Western countries. The situation is particularly serious for elderly women immigrants. Because women have a longer life expectancy than men, older women from ethnic minorities might spend the last years of their lives in poor health and with poor quality of life. Therefore, one of the major challenges for public and primary health care will be to increase knowledge about how to encourage optimal health and quality of life among elderly populations with different ethnic and cultural characteristics and from different social classes.

Aging in Iran

The Iranian population, which consisted of almost 70 million people, is rather young; only 7% of the population were over 60 in 2006 [7]. But the proportion of elderly persons is expected to rise in Iran, as in most other countries in the world. In 2003, life expectancy in Iran at birth was 68 years for men and 72 for women. The most common cause of death in 2002 was ischemic heart disease (21% of all deaths), followed by road

traffic accidents (11% of all deaths) [8]. Perhaps not unexpectedly, given the large percentage of all deaths caused by ischemic heart disease, the prevalence of CVD is high among elderly people in Iran [9].

Research regarding the health status and quality of life (HRQL) of the elderly population in Iran is limited. However, available data indicate that elderly Iranians in Tehran, particularly women, have poor health-related quality of life due to economic, physical, social, mental, and emotional problems [10]. Unlike in Western societies, old age in Iran, as in other traditional societies in the Middle East, earns more respect and confers more social status than youth. Elderly people, with their ritual knowledge of ancient history and customs, are at the head of each family and hold a respected position [11].

Aging in Sweden

After Italy, Greece, and Japan, Sweden has the oldest population in the world. Almost 24% of the Swedish population, or about 2.2 million people, were aged 60 or over in 2006 [12]. Population projections show that by 2035 the greater part of population growth in Sweden will be in groups that are not of working age. In 2006, the average life expectancy in Sweden was 79 years for men and 83 years for women. Mortality is falling more for men than for women. According to the National Board of Health, CVD was the most common cause of death for both women and men in Sweden in 2005, followed by cancer [13].

In Sweden, a growing elderly population, e.g., the Swedish cohort born in the 1940s, will change the demographic and socioeconomic map of Sweden because they are healthier and wealthier than previous cohorts (aged 60 to 69) born in the 1920s or 1930s. Nevertheless, even a healthier and larger population of people in their 60s will, with increasing age, make increasing demands on the health care system that will vary with age, gender, SES, race/ethnicity, and country of birth.

Aging populations are likely to pose a special challenge to the Swedish primary health care system, particularly in light of the January 2008 “Vårdval” (health care choice) reform in Stockholm County, which reimburses primary health care centers by patient age, but not by SES or country of birth. Previous research has shown that not only country of birth, but also low SES, a frequent characteristic of immigrant populations, increases the risk of poor health (defined as impaired mobility and impaired working capacity) in people age 55 to 74. This, in turn, results in a larger need for health care [14]. Another study has shown that a number of elderly immigrant groups have an increased risk of impaired instrumental activities of daily living compared to Swedes, even after adjustment for SES [15]. Thus, elderly immigrants represent a large and growing group of people with special primary health care needs due to country of birth and low SES, but extra funds have not been budgeted to address these special needs.

Studies have also shown that immigrants in Sweden who are retired or in transition to retirement have a disadvantaged risk profile for CVD. For example, elderly foreign-born people ran an increased risk of engaging in no physical activity (men only), being a current smoker, and having an increased BMI after adjustment for SES [16]. The authors concluded that “the burden of being an elderly migrant increases the risk of a disadvantaged lifestyle between 50 and 80% compared with Swedes.”

MIGRATION

Worldwide

Rapid demographic changes at the start of the 21st century due to movement of migrants, refugees, and asylum seekers have profound economic, social, and cultural effects in countries of origin, transit, and destination. The United Nations (UN) and the International Organization for Migrants (IOM), estimated that about 3% of the global population, or 191 million people, were migrants during 2005 [17, 18]. According to the IOM, immigrants' health is one of the many dimensions of immigration, and policy makers and experts around the world should be attentive to this issue in order to deal with the migration pressures expected this century.

The concept of migration and immigration in Iran

Iran is a country of origin and transit for migrants and the third largest refugee-hosting country in the world.

The first wave of modern emigration from Iran started in the mid-1950s and primarily consisted of college students, who were studying abroad in order to meet the needs of the rapidly developing Iranian economy. The second wave of emigration from Iran started in connection with the Islamic Revolution of 1978 to 1979 and expanded due to Iran-Iraq war in the early 1980s. The third wave of emigration consists of the relatives (often the parents) of immigrants who leave Iran to live with their family members who are already settled in other countries all over the world.

Because the definition of *immigrant* differs from country to country, it is difficult to estimate the number of Iranian immigrants and refugees living outside the country. It seems that no official sources have kept track of the emigration of Iranians from the country over a longer period of time. However, estimates from unofficial sources such as Wikipedia put the number at up to 6 million [19]. In the United States, which has one of the largest Iranian immigrant populations in the world, the 2000 census indicated 330,000 Iranian immigrants. Whereas the Iranian Interest Section in Washington, DC, claims to hold passport information for approximately 900,000 Iranians in the US. However, because of the way the census question was asked and because many people may have been reluctant to answer the question due to privacy concerns, the real number is estimated to be much higher [20].

The concept of migration and immigration in Sweden

The history of migration to Sweden began in the 12th century, when Germans settled in the Swedish towns of Visby and Stockholm. Between the 1850s and 1930s Sweden became a migrant country because of famine, which resulted in the emigration of nearly 1.3 million Swedes, of the entire population. Most of these emigrants went to North America; fewer went to South America.

A wave of migration to Sweden started during World War II. According to the Migration Information Source, the modern era of immigration to Sweden can be divided into four different periods, with each period representing different types of immigrants and immigration. This source writes that:

- 1) Refugees from neighbouring countries (1938 to 1948)
- 2) Labour immigration from Finland and southern Europe (1949 to 1971)
- 3) Family reunification and refugees from developing countries (1972 to 1989)
- 4) Asylum seekers from south-eastern and Eastern Europe (1990 to present) and the free movement of EU citizens within the European Union [21].

Today, about 13% of the total population in Sweden are first-generation immigrants (i.e., born outside Sweden) [12], and according to Statistics Sweden, the group of Iranian-born persons in Sweden is the second largest group born outside Europe (Table 1). About 21% of immigrants in Sweden are aged 60 or above, and elderly Iranians are the largest group of elderly persons in Sweden born outside Europe (Table 1).

Table 1. The population size of the largest groups of immigrants and elderly immigrants and the proportion (%) of immigrants aged 60 or older in Sweden. December 2007 by country of birth (Statistics Sweden).

Country of birth	All immigrants	Elderly immigrants
Finland	180,906	78,611 (43)
Germany	43,044	20,649 (48)
Norway	44,727	18,325 (41)
Denmark	44,444	16,815 (38)
Yugoslavia	73,671	14,623 (20)
Poland	51,743	8,750 (17)
Bosnia-Herzegovina	55,465	7,442 (13)
Estonia	9,820	6,421 (65)
Hungry	13,711	6,025 (44)
Iran	55,747	5,074 (9)
Turkey	37,107	4,418 (12)
Iraq	82,827	4,383 (5)

CARDIOVASCULAR DISEASE AND MIGRATION

Definition of cardiovascular disease

Cardiovascular disease (CVD) includes coronary heart disease (CHD), cerebrovascular disease, hypertension, heart failure, and rheumatic heart disease and accounted for 30% of all mortality in the world in 2005 [22]. Arteriosclerosis is a general term for several disorders that start to develop early in life and cause thickening and loss of elasticity in the arterial wall, narrowing of the coronary arteries, and reduction of blood flow to different organs. Arteriosclerosis is one of the main causes of CVD [23]. Lifestyle factors are major determinants of prevalence of CVD in populations. This means that

lifestyle changes can also change the disease pattern in favorable or unfavorable directions. According to WHO's estimation 80% of all CVD, 90% of all diabetes type 2 and 30% of all cancer could be prevented by eating healthy food, increasing physical activity and avoiding smoking [24]. In addition, multi-professional diet and exercise interventions studies have demonstrated the possibilities and efficacy of lifestyle-intervention programs in populations with high risk of CVD. [25-27]

Risk factors for cardiovascular disease among elderly people

CVD is one of the main causes of morbidity and mortality among older people [28, 29]. Risk factors common among elderly, such as hypertension, obesity, diabetes mellitus (DM), and physical inactivity [30-34], accelerate the process of arteriosclerosis and can explain the high prevalence of CVD among elderly. Furthermore, the increasing average life span prolongs the duration of exposure to CVD risk factors and increases the risk of clinical CVD events.

Physical inactivity

People who stop doing physical activity become depressed and lose their hope in life. The body's organs lose energy and vitality.

So said Avicenna, the Persian physician and philosopher who lived ten centuries ago.

Physical activity is any behavior that involves all large muscle movements for any purpose and results in energy expenditure. Exercise can be defined as physical activities with purposive movements that result in the contraction of skeletal muscles with the aim of improving cardiorespiratory or muscular fitness. Physical inactivity is defined as no physical activity at all or movement fewer than three times a week and less than 20 minutes each time [35].

According to WHO, physical inactivity is estimated to cause 2 million deaths worldwide annually, and the risk of CVD is 1.5 times higher in physically inactive than in physically active people. Physical inactivity among elderly persons is one of the main factors that lead to reduced fat-free mass (mostly muscle), which in turn contributes to fat accumulation and lower energy expenditure [36]. Decreased energy expenditure together with unchanged energy intake and physical inactivity contributes to positive energy balance and increase body fat, mainly in the abdominal area. In the aging population, these alterations in body composition are the major risk factors for CVD [37]. Furthermore, regular physical activity seems to attenuate many of the health risks associated with overweight, obesity, and CVD [38]; active obese individuals seem to have lower morbidity and mortality than normal-weight individuals who are sedentary [39, 40].

Obesity

According to WHO:

Obesity and overweight are defined as an accumulation of excess body fat, to an extent that may impair health. A crude population measure of excess fat is the body mass index (BMI), a person's weight (in kilograms) divided by the square of his or her height (in meters). WHO defines overweight as a BMI of 25 or more, and obesity as a BMI of 30 or more. These cut-off points can provide a

reference for individual assessment. There is also evidence that, on a population level, the risk of chronic disease increases progressively as average BMI increases above 21. A high body mass index is a major risk factor for a number of chronic diseases, including cardiovascular diseases, cancer and diabetes.

Today, obesity has reached epidemic proportions worldwide. This is an alarming issue because the tendency to become obese increases with age, and population structures are changing with what the United Nations calls an unprecedented, pervasive, and enduring trend toward aging in the world population [41].

However, the impact of overweight and obesity on mortality among elderly is widely debated. Hence, standard BMI guidelines may be too restrictive for use in elderly populations [42]. While excess mortality from all causes and CVD in middle-aged population begins to rise at BMI 25, in persons over 60 years excess mortality first begins to rise at BMI 30 in men and BMI 33 in women [43]. However, in a recent study, Flegel et al. found that underweight and obesity but not overweight are associated with CVD mortality among persons over 70 [44]. Although the impact of obesity on mortality in elderly persons is still under debate, it is clear that obesity causes several medical complications that contribute to substantial physical and psychological morbidity, disability, and impaired quality of life among elderly persons [45]. In spite of global epidemiological studies that clearly demonstrate the risk of obesity for health in people of all ages, it is important to consider that large body size is culturally valued in many Asian and African communities as a sign of healthiness and material wealth. Consequently, the recommendations and treatments that aim to change diet and lifestyle may not be successful among certain ethnic groups [46]. It may also partly explain the high prevalence of obesity in non-Western societies undergoing nutritional transition.

In persons aged 65–84 in Sweden, the prevalence of obesity (BMI > 30) was almost 12% and underweight (BMI < 18.5) less than 3% in 2001 [47]. Despite the high prevalence of obesity, most attention from policy makers and national organizations in Sweden remains focused on diagnosis and treatment of malnutrition due to underweight among elderly. Although malnutrition is an important clinical and public health issue and is associated with mortality and acute and chronic illness, the increasing burden of obesity among elderly people should not be underestimated. Future community and primary care studies should be performed to develop treatment strategies, practical recommendations, and guidelines for weight management in elderly persons. Furthermore, those who develop public health strategies for the prevention and treatment of obesity should consider the special dietary needs of elderly persons.

Abdominal obesity

While BMI is the most widely used and accepted measurement for classifying the medical risk of obesity in young and middle-aged adults [48], it is not clear if it is a relevant measure for assessing health risk in elderly persons. Age-related changes in body compositions are accompanied by a progressive increase in the ratio between fat and lean body mass, which is associated with a greater increase in intraabdominal fat than in subcutaneous or total body fat [49]. Several studies have shown that for this reason, central fat mass or abdominal obesity, measured by waist circumference, is a significant CVD determinant among elderly people [37, 50, 51]. In addition, the global INTERHEART study showed that abdominal obesity is a much more powerful

determinant of CVD than BMI in many ethnic groups around the world [52]. An increased risk of CVD has been seen at waist circumferences ≥ 102 in men and ≥ 88 cm in women [53].

Hypertension

Hypertension, like diabetes, is both a disease and a risk factor, but is more prevalent than diabetes. Hypertension, which has the same prevalence in many developing countries as in developed countries, is one of the most important modifiable CVD risk factors, and is estimated to cause 4.5% of the current global burden of disease [54]. Age is strongly associated with systolic blood pressure (SBP) [55], and the majority of persons with uncontrolled hypertension are at least 60 years old [56, 57].

Smoking

Smoking caused more than one of every ten CVD deaths and 20% of all cancer deaths in the world in 2000 [58, 59]. The fact that smokers can be expected to have reduced life expectancy [60] contributes to limitations in the amount of studies on smoking and CVD among elderly persons. The available data indicate that excess rates of smoking-related disease rise with increasing age and duration of smoking. However, the excess mortality from lung cancer and chronic obstructive lung disease among elderly smokers equals the mortality rate from CVD among younger smokers [61]. Moreover, quitting smoking can increase life expectancy and decrease the excess risk of coronary heart disease, stroke [62], and all-cause mortality among elderly persons [61, 63].

Diabetes Mellitus

According to WHO:

Diabetes mellitus is a chronic disease caused by inherited and/or acquired deficiency in production of insulin by the pancreas, or by the ineffectiveness of the insulin produced. Such a deficiency results in increased concentrations of glucose in the blood, which in turn damage many of the body's systems, in particular the blood vessels and nerves.

Diabetes mellitus (DM) is one of the major risk factors for CVD [64]. However, the prevalence of DM differs with age group, sex, and part of the world. Globally, the prevalence of DM is higher among elderly women than elderly men. Moreover, the prevalence of DM is higher among older than younger populations in developed countries. But in developing countries, the majority of people with DM are under 64 [65]. However despite differences, physical inactivity and obesity (especially abdominal obesity) appear to be powerful determinants of DM among men and women of all ages around the world.

In 1997, the American Diabetes Association (ADA) proposed the diagnostic criteria for DM, which were accepted by WHO in 1998 and confirmed that, regardless of age, fasting plasma glucose (FPG) higher than 126 mg/dl in the morning should be indicative of DM. Meanwhile, subjects with FPG 110–125 mg/dl have an impaired fasting glucose (IFG), and up to 110 mg/dl is considered normal fasting glucose. After a review in 2005, WHO and the International Diabetes Federation recommended that these criteria be maintained [66]. However, about 30% of individuals with DM remain

undiagnosed when FPG is used as the exclusive criteria [66]. In this thesis, type 2 diabetes (formerly named non-insulin-dependent), which accounts for around 90% of all diabetes cases worldwide was studied.

Dietary habits

If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health (Hippocrates ca. 460–370 BC).

Many epidemiologic studies, experimental studies, and clinical trials have shown that dietary risk factors affect serum lipids, which leads to the development of arteriosclerosis and CVD. The classic Seven Countries Study [67, 68], which aimed to relate the mean intake of specific dietary items in 16 defined populations in seven countries to the incidence of heart disease was the first to show that a population with the highest saturated fat intake (> 15% of total kilocalories) had the highest CHD mortality. Early migrant studies of the role of diet and the risk of CVD confirm that the extensive differences in rates of CVD among different populations cannot be explained by genetic factors and therefore is probably due to lifestyle and other environmental factors. In particular, a study of three Japanese populations living in Japan, Hawaii, and San Francisco, respectively, showed that dietary intake has a major impact on CVD risk factors among subjects who have essentially same genetic background [69, 70].

According to WHO, about 31% of CHD and 11% of stroke worldwide are attributable to low fruit and vegetable intake. Meanwhile, diets rich in fruits and vegetables may help reduce the risk of CVD via a number of favorable effects. For example, fruit and vegetables are main sources of fiber and sterols, which reduce serum low-density lipoprotein (LDL) cholesterol and total cholesterol levels [71], as well as blood pressure [72].

One might argue, however, that assessing dietary intake can never be reliable because most dietary surveys are based on self-reports of food intake over varying periods of time. Therefore, description of dietary intake represents a methodological challenge. For example, under- and over-reporting of energy intake may affect the accuracy of survey results. However, the extent of under- and over-reporting varies among individuals and is associated with age, sex, BMI, and lifestyle factors such as smoking [73, 74].

To date, most studies have focused on assessing the effects of ethnic differences on CVD risk factors but have paid little attention to dietary factors, which play an important role for health and especially in the development and progress of CVD. A major advantage of the research for this thesis was the opportunity to determine the risk factors for CVD among elderly men and women with fundamentally same genetic-ethnic background, but different dietary habits, living in different environments.

Socio-demographic factors associated with cardiovascular disease

Socioeconomic status

Socioeconomic status (SES), synonymous with the terms social class, socioeconomic position, social status, and social position, is a multidimensional concept influenced by the general theories of social development propounded by Karl Marx and Max Weber,

describing the position that individuals hold in society. SES includes skills, education and other qualifications which are important for jobs, societal position, and the prestige people can attain, and probably they measure different aspects of SES [75]. Differences in SES between individuals and groups in society lead to social stratification and social inequalities. There are a variety of ways to operationalize SES, according to different traditions of social development. It is also important to have data on SES. The most common ways to measure SES are in terms of income level and/or wealth, educational status, or occupational status. These measures of SES could be regarded as a reflection of the individual's resources, skills, and knowledge. These different measures of SES are also predictors of an individual's life chances and subsequently individuals' health status. Previous research has documented that the association between SES and health is consistent in different countries and in different times [76-79]. It has been shown that no SES measure is conceptually "better" than any other [80]. They are also highly correlated to each other, at least in most Western countries where a high level of education normally has resulted in a better income.

Furthermore, many immigrant groups have low SES, which in the majority population is associated with an increased risk of hospital admission for cardiovascular disorders [81]. This implies that SES and ethnicity are two separate concepts that have an impact on various life circumstances in immigrants, including health. It is possible that SES is less important in higher age for CVD because people with low SES have died before or during the first decade of retirement.

In this thesis, education was only used as a crude proxy of SES. At first, using income to characterize SES was considered. However as 76% of the elderly Iranians living in Sweden who participated in this study arrived in Sweden when they were 50 years or older they were not eligible for full pension and thereby have very low incomes. Because of their low pension rights and dependency on welfare aid, income is a blunt tool to differentiate individuals by SES in this particular group.

Even using occupation as an indicator of socioeconomic status seems to be less valid in this group of immigrants because almost all of them are at the age of retirement. In addition, many immigrants in Sweden work in low-status jobs even though they have university degrees. Therefore, education was considered to be a more stable indicator of SES in this particular group. Furthermore, education as a measure of SES is rather unaffected over the course of life and the health status. In addition, health status may influence income and occupation but not educational status. Moreover, years of education as a proxy for SES is one of the most important determinants of CVD [82-84].

Marital status

Several studies have reported excess risk of CVD mortality among widowers and divorced men [85, 86]. In contrast, being divorced and being widowed are not associated with higher all-cause or CVD mortality among women [85, 87].

In Iran as in many other societies, women tend to marry older men. Consequently, lower age at marriage, and longer life expectancy of women, may cause higher proportion of widows than widowers. Moreover, studies from other countries show that men are more likely to remarry than women and remarried men have longer life expectancy than widowers [88].

Risk factors related to migration

Previous well-known migrant studies of Japanese immigrants to the United States [69, 89, 90] and European immigrants to Australia [91] provide strong evidence for the influence of environmental and lifestyles factors in the etiology of CVD. A longitudinal cohort study of 654 adults with subsistence lifestyle from Tokelau Island who migrated to urbanized Western lifestyle in New Zealand found higher BMI among men and women and higher prevalence of hypertension among men who migrated than among the non-migrants [92]

Other studies of immigrants and their health describe the migration process as highly selective for health. For example, Marmot et al. showed that for every country of birth, except Ireland, immigrants had a lower standardized mortality ratio than that prevailing among the indigenous population. They proposed the existence of selection on health grounds: that poor health was likely to be a barrier to migration, and a healthy migrant effect, that only strong people migrate [93]. In 2006, a Swedish study revealed a lower all-cause mortality risk in the majority of immigrant groups in Sweden than in their country of birth, in some cases extraordinarily lower. The authors interpreted the finding as a decrease in all-cause mortality, but it could also be selection bias, that healthy migrants are more apt to emigrate, i.e. the “healthy migrant effect” [94]. Not only the accurate screening and detection of existing health problem by the new host country government but also younger adults’ migration is selective of people whose health is better than that of non-migrants[95]. On the other hand, poor health may be a reason for migration amongst older people because elderly people with poor health may move to a new country to be closer to their families [95, 96]. In addition the fact that Sweden does not screen immigrants for health means that elderly immigrants can migrate to Sweden regardless of health. Moreover, other studies in Sweden also show that the prevalence of risk factors for CVD, such as obesity, hypertension, smoking and diabetes, is high among immigrant populations [16, 97, 98].

Country of birth

Several terms are used in epidemiological research to describe a person’s cultural characteristics. The most commonly used terms are: ethnicity, race, country of birth, country of origin, foreign-born, migrant, refugees and labor migrants. The terms “country of birth” and “migration status” have been used in this thesis. Although ethnicity may occasionally appear in surveys, it is not possible to use such concepts as religion, ethnicity, or race according to Swedish law, and therefore these concepts are not included in Swedish registers. The official key groups are country of birth, citizenship, and parents’ citizenship(s). Several studies have identified the impact of country of birth on dietary patterns, physical inactivity, increased BMI, smoking, and abdominal obesity, which are the major risk factors for incidence of CVD [16, 99-101].

Acculturation

Acculturation is a complex and multidimensional process, involving immigrants’ employment in the new country, mastery of the host country’s language, ability to communicate with the host population [102], and length of time since migration [103, 104]. In this thesis length of time in Sweden has been used as a proxy for acculturation. This has been done because length of time in a new country is associated with several risk factors for CVD [104-106].

In an attempt to develop a measure of acculturation, Zea et al. suggested that “acculturation is a process by which individuals retain characteristics of the culture of origin while simultaneously acquiring characteristics of the new culture. Acquisition of some characteristics may sometimes translate into losing others, but this is not always the case and may depend on the setting or cultural context in which the individual lives” [107].

Early studies of the role of acculturation in cardiovascular health identified a “healthy migrant effect,” which implies that immigrants are healthier people, who are more able to migrate and be mobile and generally have better health outcomes than those who do not move, but that this effect tends to diminish over generations, as the health of immigrants converges to the host country’s norm. In the case of Western societies, diet and lifestyle have an important impact on hypertension [108]. Studies of the role of acculturation on the cardiovascular risk factors and health of Hispanics residing in the United States have supported this healthy migrant hypothesis. For example, the main hypothesis in the following article was that men and women born in Mexico (first-generation Mexican-Americans) would have healthier cardiovascular profiles than those born in the US because of positive social and cultural influences from their country of birth [109]. The authors also expected that US-born English-speaking men and women would have healthier cardiovascular profiles than US-born Spanish-speaking men and women because of higher levels of acculturation which may result in positive benefits from the majority culture, including opportunities for higher education and income; access to preventive health services; and effective screening, diagnoses, and treatment of CVD-related conditions. In contrast, they expected that US-born Spanish-speaking men and women would have the least healthy profiles due to weakened ties with their traditional Mexican culture and poorly established ties with American culture, indicating a loss of protective influences of their native culture before a gain of protective influences associated with the dominant English-speaking culture. Consistent with the hypothesis, Mexican-born men and women had the healthiest cardiovascular profiles and US-born Spanish-speaking men and women had the least healthy profiles after accounting for age and educational attainment. This latter group represents a newly identified group that has a substantial risk of CVD and is in need of effective heart disease prevention programs.

A considerable part of the observed deterioration of cardiovascular health associated with acculturation can be explained by changes in lifestyle (e.g., diet, physical activity and smoking) [105, 106, 110, 111] combined with psychological stress such as social degradation, social isolation, and cultural distance, all of which are consequences of migration [75, 77].

Cardiovascular disease and health-related quality of life

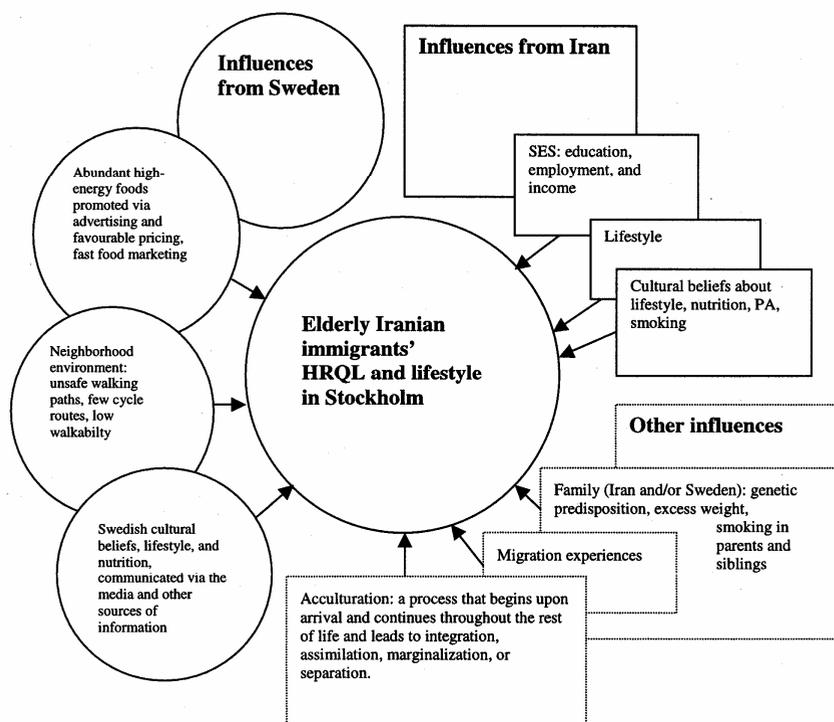
Health-related quality of life (HRQL) is a fundamental measure used to understand the health status of a population. Impaired HRQL independently predicts mortality and CVD-related hospitalizations [112]. Meanwhile CVD risk factors such as DM [113], hypertension [114] and obesity [115] among the elderly population contribute to impaired HRQL [116]. In addition, SES [117, 118], age [119, 120] and ethnicity [121] are significant common determinants for CVD and impaired HRQL. This is an important issue regarding elderly immigrants, as old age, different ethnicity and often low SES make them vulnerable to impaired HRQL and contribute to cardiovascular

morbidity, which puts them at risk of worsening HRQL. For this reason, it may be argued that if the excess rates of CVD incidence and mortality are due to impaired HRQL, then they may be prevented or decreased by improving HRQL among elderly and particularly elderly immigrants. Furthermore measurement of HRQL in patients with or without CVD provides important information in addition to a clinical assessment. Inclusion of HRQL assessments in clinical practice is practical and necessary and may contribute to appropriate intervention for improving HRQL [122].

Theoretical model of the impact of migration on health-related quality of life and cardiovascular risk factors

According to this introduction, HRQL and CVD risk factors among elderly Iranians immigrants in Sweden are influenced by multifactorial processes, as shown in figure 1.

Figure 1. Multifactorial processes that influence health-related quality of life and cardiovascular risk factors in elderly immigrants from Iran.



In this thesis it is only possible to analyze a limited portion of the multiple and complex factors that influence HRQL and cardiovascular risk factors in Iranian immigrants ≥ 60 years who are resident in Stockholm, Sweden (see figure 1).

Influences from Iran and Sweden

SES (individual-level education, employment, and income) in Iran can have an impact on HRQL and cardiovascular risk factors in elderly Iranians who migrate to Sweden. Other influences from Iran include immigrants' lifestyle habits, as well as the cultural beliefs they bring with them about lifestyle, nutrition, physical activity, and smoking. The binary classification of health-related behavior norms and food are some of most common cultural beliefs among Iranians and have major implications for health status. Results of a study among elderly Iranian immigrants in Sweden emphasized that the participants differed concerning sources of health such as continuity and balance in life and sources of illness such as discontinuity and imbalance in life [123]. Moreover the use of humoral theory in food consumption is a characteristic of many cultural groups in the Middle East and particularly Muslims. The division of all foodstuffs into two groups, usually called "hot" and "cold," does not refer to actual temperature, but rather to certain symbolic values associated with the food category as hot or cold. According to this humoral theory, ill-health is caused by an imbalance between hot and cold foods and should be treated by food to restore the balance. These kinds of cultural beliefs and behavior, especially those used as form of self-medication, in some cases may have a considerable impact on health and well-being [46].

Influences from Iran are balanced by influences from Sweden, which may also affect elderly Iranian immigrants' HRQL and lifestyle. For example, in Sweden and many other industrial countries, life in the first decade of the new millennium is characterized by an environment that encourages behaviors related to overweight and obesity. High-energy foods are plentiful, promoted via advertising, priced favorably, and readily available. For instance, Stockholm's Central Station has abundant fast food restaurants.

A large proportion of immigrants are settled in deprived neighborhoods. The neighborhood environment can be either a powerful barrier to or an asset for physical activity, which in turn can affect overweight, obesity, and related health outcomes [124-127]. Unsafe walking paths, few cycle routes, and low walkability are a few of the barriers to physical activity that can be found in many deprived neighborhoods. Recent research has established an association between neighborhood social deprivation and CHD [128-130]. Low SES neighborhoods are also associated with an increased prevalence of CHD risk factors [131, 132], including not only physical activity, but also high diastolic blood pressure, poor dietary habits, elevated cholesterol levels, smoking, and obesity [133-137].

Other influences

Genetic predisposition

It is well known that the etiology of cardiovascular risk factors such as obesity is multifactorial, involving a complex interaction among genetic, hormonal and environmental factors [138]. In a process known as vertical cultural transmission, health behaviors can be passed on to offspring directly by imitation or social learning [139].

Family environment

Family environment, both in Iran and in Sweden, can have an important influence on migrants' approaches to lifestyle habits. For instance, excess weight, physical

inactivity, and smoking in parents and siblings in Iran have an important influence on an individual's lifestyle habits in Sweden.

Acculturation

Acculturation plays probably an important role in determining elderly Iranian immigrants' HRQL and lifestyle. Cultural and social forces and family factors determine whether the individual Iranian immigrant in Sweden will be integrated (in both culture and language), assimilated (deny his or her own culture and language), marginalized (deny both the Iranian and the Swedish cultures) or separated (live in an Iranian culture in Sweden). Experiences from the face-to-face interviews indicate that, of those who were interviewed, approximately 90% were separated from the Swedish language and culture and a few were integrated in both the Swedish and Iranian cultures. It should be noted that for those who immigrated to Sweden at older ages the acculturation experience is probably highly influenced by how well integrated his or her family (adult children) is in Swedish society and culture. Some of the elderly Iranian immigrants immigrated as adults.

Migration experiences

Migration experiences are probably important for how the acculturation process will succeed for the migrant. For example, people coming to Sweden as political and war refugees will have a different migration experience than those who come for job reasons, to join other family members, due to marriage, or for other reasons. It is not only an individual's migration experience that is important to a migrant, but also his or her family's collective migration experience. This is true not only for husbands and wives or parents and young children, but also for elderly parents who migrate to be with their children in exile. For example, if sons or daughters have had traumatic experiences, it is likely that their elderly parents share the emotional part of the trauma. If, on the other hand, sons or daughters settled in Sweden for reasons like marriage or studies, the family's collective migration experience, and thus the elderly parent's experience, will likely be different and affect the elderly migrant differently. It should be noted that according to Swedish law, migrating to Sweden from a non-European Union country for marriage or studies is less common than migrating as a refugee.

Immigrants' SES in Sweden may be influenced by their SES in the country of origin, but it is also closely associated with the acculturation process into a new society. The more educated a person is, the easier it often is for that person to learn a new language and understand a new culture. However, regardless of education, immigrants may face social degradation due to the difficulty of finding a job. The situation is exacerbated for those who come at older ages, because to the difficulty finding a job is added a comparatively short number of working years in Sweden, which often leads to a low retirement income. Some elderly immigrants with good economic resources may travel between Iran and Sweden and keep one foot in each culture.

In this study we have the unique opportunity to compare HRQL and cardiovascular risk factors in elderly Iranians who live in an urban setting in Teheran with HRQL and cardiovascular risk factors in Iranian immigrants in Stockholm.

AIMS

GENERAL AIMS

To analyze determinants of and differences in risk factors for CVD among elderly Iranians in Sweden, elderly Swedes in Sweden and elderly Iranians in Iran.

SPECIFIC AIMS

Study I

To analyze whether elderly Iranians in Sweden have a higher mean BMI and are less physically active than Swedes. Additionally, we wished to determine whether the hypothesized association between country of birth, BMI, and physical activity remains after taking into account age, sex, socioeconomic status (educational level), marital status, and length of time in Sweden.

Study II

To determine whether there is an association between migration status (i.e. being an elderly Iranian immigrant in Stockholm, as compared to being an elderly Iranian in Tehran) and risk factors for CVD, such as general obesity, abdominal obesity, hypertension, smoking, and diabetes mellitus.

Study III

To examine whether there is an association between migration status (i.e. being an elderly Iranian in Iran, an elderly Iranian immigrant in Sweden, or an elderly Swede in Sweden) and health-related quality of life. In addition, we also analyzed whether the length of time since migration to Sweden is associated with HRQL, taking into account the variables age and education.

Study IV

To examine possible dietary differences between elderly Iranians living in Stockholm, Sweden, with elderly Iranians living in Tehran, Iran, taking into account the variables sex, age, marital status, education, and length of time in Sweden. To determine whether the hypothesized dietary differences are associated with the prevalence of overweight, general obesity, and central obesity.

MATERIALS AND METHODS

MAIN DATA SOURCES

Elderly Iranians in Stockholm

In 2004, a total of 160,000 foreign-born persons from 190 different nationalities lived in Stockholm County. Moreover, Iranians were the third largest population born outside Sweden and living in Stockholm County. According to Stockholm Office of Research and Statistics, and other municipalities in Stockholm County, in 2004, the highest proportions of Iranian aged 60–84 years lived in district of Kista, which is northernmost district of Stockholm city. In addition, more than 20% of foreign born persons aged 60–84 years in Kista consisted of Iranians.

In 2004 almost 30,000 people with different cultures and religions were living in Kista, which comprised the sub-districts of Akalla, Husby, and Kista. The eastern part of Kista is a large industrial estate with almost 500 international companies in IT and communications technology. It also has one of Sweden's largest shopping malls with the largest importer of ethnic foods from every part of the world [140].

Subject recruitment

In January 2004, all Iranian-born persons aged 60–84 who according to the population register were settled in the Kista, Stockholm (N= 286), were invited to participate in the study through a letter written both in Swedish and in Farsi, explaining the aims of the study. Of these, 16 letters were returned due to outdated address, 60 persons refused to participate and 43 did not respond to the letter despite a reminder which was sent in February 2004. One hundred and sixty-seven (62%) persons agreed to participate in the study. Within a week, the participants were contacted by telephone to book the first visit for the interview. The Iranian group was interviewed in a day center for Iranian seniors in Kista or at their home if they wished, in their native language, Farsi. Because there were several measurements and questionnaires, the interviews were conducted in two different periods in order to avoid overburdening the study participants. An overview of assessments which were conducted during the two periods of interviews is shown in table 2. Average weight was used in the analysis if weight was changed between the two interview occasions.

During interviews at the second period at the day center for Iranian seniors in Kista, nine of those who did not respond to the letter showed their interest in participating in the study. Therefore the number of participants in *Study I* (167 persons) is smaller than the number of participants in other three studies (176 persons).

Table 2. Overview of assessments which were conducted during the two periods of interviews

Assessments	First period	Second period
	2004–2005	2005–2006
Background questions*	X	
BMI	X	X
Waist and hip measurements	X	X
Physical activity	X	
HRQL	X	
Blood pressure		X
Dietary habits		X

* Including demographics, disease history, medications and smoking.

Anthropometric measurements

Body mass index (BMI) was calculated as weight/height² (kg/m²) and dichotomized into normal weight (BMI<25), overweight (25≤BMI<30) and obesity (BMI≥30). The participants were weighed with light indoor clothing, without shoes, on a portable electronic scale. Height was measured with participants in stocking feet, standing straight against a wall that had no baseboard (skirting board).

The Swedish participants' BMI values were based on self-reported weight and height, and therefore these BMI values were compensated for the known discrepancy between objectively measured and self-reported weight and height [141]. The calibration was done according to the transformed equations for:

$$\text{Women: BMI}_{\text{subj}} = 1.835 + 0.893 \text{ BMI}_{\text{obj}}$$

$$\text{Men: BMI}_{\text{subj}} = 2.292 + 0.893 \text{ BMI}_{\text{obj}}$$

where BMI_{subj} represents self-reported (subjective) values and BMI_{obj} corresponds to calibrated (objective) data.

Waist circumference was measured twice in standing position halfway between the lower border of the ribs and the hip bone, with abdomen relaxed, arms relaxed at the sides and feet together using a plastic measuring-tape. The measurements were conducted with light clothes on, and the averages of two measurements were recorded to the nearest 0.1 cm. Waist circumference was measured according to the WHO recommendation [142].

Blood pressure was taken three times on the left hand with participants in the seated position after 15 minutes of quiet rest. The average of the last two measurements was used for systolic (SBP) and diastolic (DBP) blood pressure using OMRON digital automatic blood pressure monitor with appropriate cut off sizes.

Smoking habits involved two levels: current smokers (including daily smokers, occasional smokers and those who smoke hookah) and non-smokers (including ex-smokers and those who never smoked).

Diabetes mellitus: Information about the absence or presence of diabetes was provided by the respondents in their answers to the questions “Do you suffer from any

long-standing disease?” “If so, what kind of disease?” and “Do you take medicine regularly?” “If so, what medicine do you take regularly?” If diabetes was reported as a disease or medicine was taken for diabetes, the respondent was judged to have diabetes. All others were judged not to have diabetes. All respondents who reported diabetes as a disease were also taking medicine for diabetes

Assessment of physical activity

Data on self-reported leisure-time physical activity was recorded during the interviews, and subjects were categorized into 5 levels of physical activity: very light (almost no activity at all), light (walking, non-strenuous cycling or gardening approximately once a week), moderate (regular activity at least once a week, e.g., walking, bicycling, or gardening; or walking to work 10–30 min/d), active (regular activities more than once a week, e.g., intensive walking, bicycling, or sports), and very active (strenuous activities several times a week).

Table 3. Distributions of different levels of physical activity by age, BMI, waist circumference, blood pressure and prevalence of diabetes among men and women.

	Age (years)	BMI (kg/m²)	Waist circum- ference (cm)	Diabetes (%)	SBP (mmHG)	DBP (mmHG)
Men (n= 56)	69.8	26.4	98.7	16	150.1	85.1
<i>Physical activity</i>						
Very light (n=12)	71.8	26.4	99.1	25	146.8	83.4
Light (n=13)	71.7	27.1	99.3	0	149.9	81.7
Moderate (n=2)	71	25.3	92.0	0	160.5	84.5
Active (n= 12)	67.1	26.2	96.4	25	153.3	90.0
Very active (n= 17)	68.6	26.0	100.4	17.7	149.1	85.5
Women (n=121)	70.4	29.3	97.2	21	147.8	81.9
<i>Physical activity</i>						
Very light (n= 53)	71.4	30.5	101.2	18.9	149.8	80.7
Light (n= 21)	72.8	27.2	94.3	35	145.9	77.1
Moderate (n= 8)	68.4	30.5	101.1	14.3	141.7	88.3
Active (n= 28)	69.1	28.6	93.3	14.3	146.7	83.9
Very active (n= 11)	68.8	27.5	91.1	36.4	151.0	87.5

Distributions of different levels of physical activity by age, BMI, waist circumference, blood pressure and prevalence of diabetes among men and women are shown in table 3.

Measurement of health-related quality of life

A qualitative study based on interviews of 21 Iranian in Australia shows that this population defined components of health in physical or emotional aspects, absence of disorder, holistic (integrated aspect of health), spiritual and social aspects [143]. Furthermore, another study among elderly Iranian immigrants in Sweden emphasized that the participants consider health as feeling continuity and balance in their life. In the same study social well-being and well-functioning familiar relationships have been described as the core aspects for maintaining and/or promoting health [144]. The World Health Organization (WHO, 1946) defined health as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.”

The most common way of measuring HRQL is by using standardized questionnaires, which can be generic or disease-specific. Generic instrument provide a summary of HRQL and include instruments that attempt to measure several aspects that are important to everyone and apply to a variety of populations, whereas disease-specific instruments focus on an aspect of health status of a particular patient population.

Based on definitions of health earlier in this chapter, a review of HRQL instruments was performed through the Internet using the PubMed database, in order to identify an instrument appropriate for this group of elderly. The search for articles on instruments related to quality of life was limited to age group 65+, publications in English and published during the previous 10 years, i.e. since 1994. The terms used for the search were “health related quality of life instruments,” which yielded approximately 350 articles. Abstracts of these articles reviewed with the following exclusion criteria:

- Disease-specific instruments
- No specific instruments
- Theoretical, review articles or comments on studies

A total of 28 articles relating to 10 instruments met the defined selection criteria. Further information about cultural and language adaptations was obtained through the Internet Quality of Life Instruments Database (<http://www.proqolid.org>).

The majority of these instruments included in the present review were founded to focus primarily on three dimensions: physical, emotional, and social (table 4). The SF 36 proved to be the most comprehensive instrument for the more commonly addressed dimensions in this study.

Table 4. Dimensions included in HRQL instruments with regard to definition of health mentioned by Iranian immigrants and WHO.

Instrument	Dimensions included						
	Physical	Emotional	Social	Absence of disorder and/or disease	Holistic	Spiritual	Cultural and language adaptation
AQOL	X	X	X	X			
COOP Charts	X	X	X		X		
EQ5D	X	X			X		
HUI3	X			X			
NHP	X	X	X				
OARS	X	X	X				
SF 36	X	X	X	X	X		X
SF 12	X	X	X		X		
SIP	X	X	X				
WHOQOL-100	X	X	X			X	

AQOL = Assessment of Quality of Life [145], The COOP Charts [146], EQ5D = EuroQol Instrument [147], HU13= Health Utilities Index [148], NHP = Nottingham Health Profile [149], OARS = Multidimensional Functional Assessment Questionnaire (OMFAQ) [150], SF-36[151], SIP = Sickness Impact Profile [152], WHOQOL-100 [153].

Assessments of dietary habits

Dietary assessments are described in detail in paper IV. Briefly, a semi-quantitative food frequency questionnaire (FFQ) was adapted from the dietary survey of the Swedish population which was carried out by the National Food Administration (NFA) in collaboration with Statistics Sweden [154]. The FFQ was conducted face-to-face during 30 minutes. Data obtained from the FFQ were entered into DIETIST XP software [155], which is based on food tables from the National Food Administration [156] that include almost 1600 items and 50 nutrients.

The FFQ was validated by Goldberg's Cut-off [157], in order to estimate the number of individuals with acceptable reporting of dietary intake. The model is based on the ratio of reported energy intake (EI_{rep}) from the FFQ and estimated basal metabolic rates (BM_{Rest}) and physical activity level (PAL). BM_{Rest} was estimated from the Schofield equations [158] for persons older than 60 years, and PAL was systematically estimated for each subject according to a method developed by Johansson et al. [159].

Approximately 80% of the participants were acceptable reporters, 14% were over-reporters and 6% were under-reporters. After exclusion of subjects who were over-reporters and under-reporters, 121 subjects (41 men and 80 women) remained in the final data analysis.

Characteristics of acceptable reporters, over-reporters and under-reporters by demographic and lifestyle pattern are shown in table 5.

Table 5. Characteristics of acceptable reporters, under-reporters and over-reporters by demographic and lifestyle pattern.

Demographic and lifestyle patterns	Category	Acceptable reporter	Under-reporter	Over-reporter
Sex	Men (%)	82.0	4.0	14.0
	Women (%)	78.4	6.9	14.7
Age (years)	Mean	68.6	64.6	72.5
Education	> 9 years	47.1	33.3	22.7
	≤ 9 years	52.9	66.7	77.3
Energy intake (Kcal)	Mean	2402	2617	4469
BMI (kg/m ²)	Mean	27.9	33.9	27.9
PAL	Mean	1.7	1.6	1.6
Smoking	%	43.0	44.4	45.5

The Swedish Survey of Living Conditions (SALLS)

SALLS is a comprehensive survey that has been conducted annually by Statistics Sweden since 1974. Today, SALLS is one of the oldest and most extensive information systems in the world, with approximately 200,000 interviews and 700 variables. The surveys are based on simple random samples drawn from Statistics Sweden's updated register of the total population, including all Swedes and foreign-born people with permanent residence in Sweden aged 16–84 years. The surveys were conducted face-to-face and included four main social dimensions: health, social relations, work, and physical environment. However, almost all data in SALLS are self-reported, which means that they represent subjective evaluations rather than objective measures. Nevertheless, the reliability and validity of the questions taken from the SALLS have been found to be high [160] and the self-reported measures used in SALLS are reliable [141, 161, 162]. SALLS was used in Study I.

Tehran Lipid and Glucose Study (TLGS)

TLGS is a study to determine the risk factors for atherosclerosis among the Tehran urban population and to develop population-based measures to change the lifestyle of the population and to prevent the rising trend of diabetes mellitus and dyslipidemia. The design of this study encompasses two major components: phase 1 is a cross-sectional prevalence study of CVD and associated risk factors conducted between February 1999 and August 2001. Phase 2 is a prospective follow-up study for 20 years started from September 2001. A multistage stratified cluster random sampling technique was used to select people from Tehran urban district 13, based on family units. Of the original population which consisted of nearly 27,500 people (7146 households) aged ≥ 3 years, 9182 persons responded. Following this, another 10,000 were randomly selected from reference population, of whom 5823 participated. Overall 15,005 subjects participated in TLGS.

Tehran, the capital of Iran, is a metropolitan city composed of 20 urban districts, which incorporates a population of more than 7 million people. There were two important reasons for choosing district 13: (1) the greater stability of the population residing in the district compared to other districts of Tehran and (2) the age distribution of the population of district 13 is representative of the overall population of Tehran. In addition to the main study, an assessment of dietary habits was performed on 283 randomly selected households by using FFQ and/or two 24-hour dietary recalls [163]. TLGS was used in Studies II and IV.

Swedish SF-36 national normative database

This database was developed by the Health Care Research Unit at Sahlgrenska University Hospital and University of Gothenburg, who translated and validated the Swedish version of the SF-36 Health Survey. The SF-36 was administered in seven general population studies

The SF-36 was administered during 1991–1992, through mail-out/mail-back questionnaires in seven different communities with an average response rate of 68%. The 8930 respondents varied by gender (48.2% men), age (range 15–93 years, mean age 42.7), marital status, education, socio-economic status, and geographical area [151]. An age- and sex-matched reference sample (n=151) was randomly drawn from the Swedish SF-36 national normative database for Study III.

Iranian SF-36 national normative database (Iranian S-F36)

This database was provided on a population-based study which aimed to develop and validate the Iranian version of the Short Form Health Survey (SF-36) for use in health-related quality of life assessment in Iran. To select a representative sample of the general population a stratified multi-stage area sampling was applied. Every household within 22 different districts in Tehran had the same probability of being sampled. Of 4804 healthy individuals who were approached, 4163 (87%) agreed to be interviewed. The mean age of the respondents was 35.1 years, 52% were women, mostly married (58%), and the mean length of their formal education was 10 years [164].

Of the non-responders 230 were women and the remaining 411 were men. The main reason for not participating was due to the fact that after two approaches most of these individuals were not available in their home. The SF-36 was administered to a random sample of healthy individuals aged 15 years and over living in Tehran. A team of trained interviewers collected data and all participants were interviewed in their homes [164].

Study III was based on a population-based representative sample of elderly Iranians in Kista/Stockholm, an age- and sex-matched group from the Swedish SF-36 national normative database and an age-matched group from the Iranian SF-36 national normative database.

METHODS

Table 6 shows an overview of the four studies by data sources, outcome, design, population size, etc.

Table 6. An overview of the four studies.

	Study I	Study II	Study III	Study IV
Data source	SALLS Elderly Iranians in Stockholm	Elderly Iranians in Stockholm TLGS	Iranian SF-36 Elderly Iranians in Stockholm Swedish SF-36	Elderly Iranians in Stockholm TLGS
Outcome	BMI Self-reported leisure-time physical activity	General obesity Abdominal obesity Hypertension Smoking Diabetes Mellitus	SF-36 with eight dimension	Macronutrients Fiber Food items Overweight General obesity Central obesity
Explanatory variables	Country of birth Age Marital status Education	Migration status Age Marital status Education	Migration status Age Education	Migration status Age Marital status Education Years of residence in Sweden
Number of participants	402	476	625	173
Study design	Cross-sectional	Cross-sectional	Cross-sectional	Cross-sectional
Measure of risk	β -coefficients (Linear regression) Odds ratio (Unconditional logistic regression)	Odds ratio (Unconditional logistic regression)	β -coefficients (Multiple linear regression)	β -coefficients (Multiple linear regression) Odds ratio (Unconditional logistic regression)
Interview period	2004	2005–2006	2004	2005–2006
Age	60–84	60–84	60–84	60–80
Response rate				
SALLS	80%			
Elderly Iranians in Stockholm	62%	65%	65%	65%
TLGS		40%		40%
Iranian SF-36			87%	
Swedish SF-36			68%	

Outcome variables

Body Mass Index (BMI) was calculated as weight/height² (kg/m²) (Studies I, II, IV). “Overweight” was defined as $25 \leq \text{BMI} < 30$ and “general obesity” as a $\text{BMI} \geq 30$.

Abdominal obesity, or central obesity, was categorized into two categories in each sex (Study II), defined as a waist circumference > 102 cm for men and > 88 cm for women [53].

Leisure-time physical activity was dichotomized into two groups based on the five levels below (Study I) : (1) physical inactivity/occasional leisure-time physical activity (levels 1 and 2 below) and (2) \geq once-weekly leisure-time physical activity (levels 3, 4 and 5 below). Five initial levels of activity: (1) practically no exercise at all, (2) occasional exercise (e.g., 1-hour walks, skiing a couple of times every year, swimming, picking mushrooms [a popular fall activity in Sweden]), (3) regular exercise about once a week (e.g., fast walks, skiing, swimming, jogging, cycling); (4) regular exercise about twice a week (e.g., fast walks, skiing, swimming, jogging, cycling); (5) vigorous exercise at least twice a week (e.g., skiing, swimming, running, cycling for quite a while, ball sports).

Hypertension was categorized into two categories: $\text{SBP} \geq 130$ and $\text{DBP} \geq 85$ mmHg [165]. Blood pressure was measured according to WHO’s recommendations [142] (Study II).

Smoking habits compromised two categories: current smokers (including daily smokers, occasional smokers and those who smoke hookah) and non-smokers (including ex-smokers and those who never smoked) (Study II).

Diabetes mellitus (DM) was categorized into two categories, yes or no (Study II). In Stockholm, information about the absence or presence of DM was provided by the respondents in their answers to the questions “Do you suffer from any long-standing disease?” “If so, what kind of disease?” and “Do you take medicine regularly?” “If so, what medicine do you take regularly?” If DM was reported as a disease or medicine was taken for DM, the respondent was judged to have DM. All others were judged not to have DM. All respondents who reported DM as a disease were also taking medicine for diabetes. In Tehran, the subjects were categorized as diabetic if their fasting plasma glucose was ≥ 126 mg/dl or if their 2-h glucose test was ≥ 200 mg/dl. In this thesis diabetes type 2 was studied.

The SF-36 measures eight health-related concepts (Study III): physical functioning (PF-10 items), role limitations due to physical problems (RP-4 items), bodily pain (BP-2 items), general health perceptions (GH-5 items), vitality (VT-4 items), social functioning (SF-2 items), role limitations due to emotional problems (RE-3 items), and perceived mental health (MH-5 items). The first four dimensions are related to physical health, while the last four are related to mental health. The areas cover activities of daily living, emotional state, pain, fatigue, social participation, and perceptions of health. In addition, a single item that provides an indication of a perceived change in the general health status over a one-year period (health transition) is also included in the SF-36. The items can be summed up to give scores of 0–100. A higher score indicates a better HRQL for a particular area [151].

Explanatory variables

Country of birth was categorized as (1) born in Sweden and (2) born in Iran (Studies I, III).

Years of residence in Sweden comprised two categories: 15 years or less and more than 15 years of residence in Sweden. The cut-point 1988/89 was chosen in order to obtain two groups of uniform size. This categorization was performed as previous research has shown an association between time in Sweden and overweight/obesity [105] (Studies I, III, IV).

Migration status was defined as Iranians in Sweden or Iranians in Iran (Studies II, III, IV).

Age was categorized into the following groups: 60–69, 70–79, and 80–84 years (Studies I, II).

Age was categorized into the following age groups: 60–69 and 70–84 (Study III).

Age was categorized as 60–64, 65–69, 70–74, and 75–80 years (Study IV).

Marital status comprised two groups: living alone = not married (including those who were widowed or divorced) and married/cohabiting (Studies I, II, IV).

Educational status comprised two categories: (1) ≤ 9 years of education and (2) > 9 years of education (Studies I, II, III, IV).

Statistical analysis

Studies I–IV

The results of the unconditional logistic regressions are shown as odds ratios (OR) with 95% confidence intervals (CI). The reference group has an OR of 1. The fit of a model was judged by using Hosmer-Lemeshow's goodness-of-fit test for logistic regression [166] and the fit was considered good if $p > 0.05$.

In linear regression, the results are shown as β -coefficients with 95% confidence intervals (CI). The reference group has a β -estimate of zero, which means that the value of the β -coefficient corresponds to the difference in e.g. BMI units or score in SF-35 between each category and the reference category. For linear regression, explained variance (R^2) was used as a measure of goodness-of-fit.

Definition of confidence interval: If repeated random samples were drawn and a 95% confidence interval for the estimated parameter is constructed for each sample, 95% of all intervals will contain the unknown (true) parameter μ . In our study we estimated β -coefficients, which indicate that if the CI contains zero, the β -coefficient is non-significant.

In all studies STATA version 9 [167] was used.

Study I

To analyze whether elderly Iranians in Sweden have a higher mean BMI and are less physically active than elderly Swedes after adjustment for possible confounders in a cross-sectional survey with face-to-face interviews of 402 men and women aged 60–84 years residing in Stockholm, Sweden.

Statistical analysis

The outcome leisure-time physical activity was dichotomized and analyzed by applying unconditional logistic regression. The following reference categories were chosen: Sweden (country of birth), 60–69 years (age), women (sex), ≤ 9 years (education), and married/cohabiting (marital status). Two models were taken into consideration: One model included sex and age in the analysis of each of the other independent variables, whereas the main model included all the independent variables simultaneously. The fit of all models was judged as good.

The BMI (continuous) was analyzed by linear regression. The reference categories were the same as those used in the logistic regression. A model that included sex and age in the analysis was estimated first. Then an interaction model was estimated including the interaction between sex and length of time in Sweden (using Swedish-born men as reference group) and also adjusted for age, educational level, and marital status. The interactions between the other independent variables were also tested (data not shown).

Study II

To analyze whether there is an association between migration status, i.e. being an elderly Iranian immigrant in Sweden, as compared to being an elderly Iranian in Iran, and the prevalence of risk factors for CVD in a cross-sectional survey with face-to-face interviews of 176 Iranians in Stockholm and 300 Iranians in Tehran, aged 60–84.

Statistical analysis

For each outcome, unconditional logistic regression was used to estimate the ORs. The following reference categories were chosen: Iranians in Iran (migration status), 60–69 years (age), male (sex), ≤ 9 years (education), and not married (marital status).

Two models were taken into consideration for each of the outcomes: An age-adjusted model and a main model. The fit of all models was judged as good ($p > 0.05$). An interaction analysis was not applicable owing to the small number of participants in each group of men and women.

Study III

To analyze the association between migration status and HRQL in a cross-sectional comparison of elderly Iranians in Sweden ($n=176$) and elderly Iranians in Iran ($n=298$) and a Swedish control group ($n = 151$) in the same age 60–84.

Statistical analysis

Scores for the eight dimensions were coded, summed up, and ranked on a scale from 0 (worst possible health) to 100 (best possible health) by means of the SAS software package [168], using the method described in the SF-36 user manual [169] and are reported for the two sexes and for each of the eight dimensions. The SF-36 scores were analyzed by multiple linear regressions. The following reference categories were chosen: Iranians in Iran (migration status), 60–69 years (age), and ≤ 9 years (education).

Two models were taken into consideration: the first one was unadjusted (crude model) and the second one (main model) was adjusted for age and education.

Study IV

To analyze whether dietary differences exist between elderly Iranians living in Sweden and elderly Iranians living in Iran, by a semi-quantitative food frequency questionnaire in a cross-sectional study of 121 Iranians living in Stockholm and 52 Iranians living in Tehran, aged 60–80. Additionally, to analyze whether the hypothesized dietary differences were associated with the prevalence of overweight, general obesity, or central obesity.

Statistical analysis

In epidemiologic studies, total energy intake is often associated with disease risk. In addition intakes of macronutrients, like every other nutrient, are strongly correlated with total energy intake but not always associated with disease rate as a result of confounding by total energy intake. Hence, in order to avoid weaker associations, it is important to control for confounding factors and remove extraneous variations in dietary intake which result from variations in total energy intake that is unrelated to disease risk [170].

In Study IV, intake of macronutrients, fiber, and food items was adjusted for total energy intake by calculating residuals from regression analysis, with total energy intake as the independent variable and each of the macronutrients, fiber, and food items as the dependent variable [170]. For each analysis, the residual was added to the expected value of the dependent variable for the mean energy intake of the sample to obtain a new mean value for each macronutrient, fiber, and food item.

Multiple linear regression analysis was used to examine possible differences in intake of energy-adjusted macronutrients, fiber, and the six major food groups (dietary variables) among Iranians living in Stockholm and Iranians living in Tehran. The following reference categories were chosen: Iranians living in Iran (migration status), 60–64 years (age), women (sex), ≤ 9 years (education), and married (marital status). Two models were taken into consideration: the first model included sex and age in the analysis, whereas the main model included all the independent variables simultaneously. Analysis of a total 20 first-order interactions was simultaneously tested in each of the 10 models. But only an interaction between sex and migrations status (using Iranian women living in Sweden as reference group) for consumption of vegetables and roots was significant, showing that Iranian women living in Sweden had the highest consumption of vegetables and roots (data not shown).

Ethical Considerations

This study was approved by the Karolinska Institute Ethics Committee (Register number: 92/03, March 10, 2003). The Ethical Committee of the Endocrine Research Center in Tehran approved the TLGS. The Ethical Committee of Medicine Science at Jahad Daneshgahi in Tehran/Iran approved the translation and validation study of the Iranian version of the Short Form Health Survey (SF-36). All participants gave their informed consent to participate in the two studies.

MAIN RESULTS

STUDY I

In this study we had the opportunity to compare BMI and frequency of leisure-time physical activity in elderly Iranians of both sexes with the same outcomes in elderly Swedish men and women after accounting for age, sex, socioeconomic status, marital status, and length of time in Sweden.

Hypothesis

We hypothesized that elderly Iranians in Sweden had a higher mean BMI and were less frequently physically active in their leisure time than Swedes after accounting for age, sex, socioeconomic status (educational level), marital status, and length of time in Sweden.

Results

Table 7 shows the β -coefficients for BMI in two models. The reference is given the value of zero so that the value of the β -coefficient corresponds to the difference in BMI for each category compared to the reference category. The sex- and age-adjusted model shows that Iranians had significantly higher BMI values than Swedes (the confidence intervals do not include 0). The highest BMI values were found among those who immigrated to Sweden in 1989 or later (β -coefficient = 2.53, 95% CI = 1.46–3.59). The interaction model shows that there was no significant difference in BMI between Swedish men (reference) and Swedish women or Iranian men. In contrast, Iranian women had significantly higher BMI than the reference group. The largest difference in BMI compared to the reference group was found among Iranian women who immigrated to Sweden in 1989 or later (β -coefficient = 3.41, 95% CI = 1.99–4.83).

Table 7. β -coefficient and 95% confidence intervals (CIs) for BMI (linear regression) by country of birth in two models: (1) Sex- and age-adjusted model and (2) Interaction model (shows the interaction between sex, and country of birth including year of immigration).

Independent variable	Category	β -coefficient	95% CI
<i>Sex- and age-adjusted model</i>			
Country of birth	Sweden	0	Reference
	Iran (immigrated in 1988 or before)	1.66	0.54–2.79
	Iran (immigrated in 1989 or later)	2.53	1.46–3.59
R ² (goodness of fit test)		0.10	
<i>Interaction model (adjusted for age, education, and marital status)</i>			
Swedish men		0	Reference
Swedish women		0.21	–0.92 – 1.33
Iranian women	Immigrated in 1988 or before	2.20	0.69–3.71
	Immigrated in 1989 or later.	3.41	1.99–4.83
Iranian men	Immigrated in 1988 or before	1.18	–0.55 – 2.92
	Immigrated in 1989 or later.	0.30	–1.61 – 2.20
R ² (goodness of fit test)		0.13	

Table 8 shows ORs for \geq once-weekly leisure-time physical activity in a sex- and age-adjusted model and in a main model adjusted for sex, age, education, and marital status. There were no significant differences in odds for \geq once-weekly leisure-time physical activity between Iranian-born and Swedish-born individuals. The length of time in Sweden had no significant impact on the odds for \geq once-weekly leisure-time physical activity. The highest prevalence of \geq once-weekly leisure-time physical activity in all groups was found in Iranian men (73.1%) and the lowest prevalence of \geq once-weekly leisure-time physical activity was found in Iranian women (52.2%), who also had the highest mean BMI (29.2).

Table 8. Odds ratios (ORs) with 95% confidence intervals (CIs) of \geq once-weekly leisure-time physical activity in Iranian-born elderly persons (categorized by length of time in Sweden) vs. Swedish-born elderly persons. Logistic regression.

Independent variable	Category	Sex- and age-adjusted model ¹		Main model ² (adjusted for sex, age, education, and marital status)	
		OR	95% CI	OR	95% CI
<i>Country of birth</i>	Sweden	1	Reference	1	Reference
	Iran (immigrated in 1988 or before)	0.88	0.51–1.54	0.95	0.54–1.67
	Iran (immigrated in 1989 or later)	0.80	0.48–1.35	1.02	0.59–1.77
<i>Education</i>	> 9 years	1.78	1.13–2.80	1.68	1.06–2.66
	\leq 9 years	1	Reference	1	Reference
<i>Marital status</i>	Married/cohabiting	1	Reference	1	Reference
	Living alone	0.68	0.43–1.07	0.73	0.46–1.17
Hosmer-Lemeshow goodness-of-fit test	p-value	0.23		0.73	

¹Sex, age, and one variable (indicated in each row) included in the model.

²All independent variables included simultaneously in the model.

Conclusion

Iranian women had significantly higher BMI than the reference group, Swedish men, after adjustment for age, education, and marital status; a finding that was in agreement with our hypothesis. The largest difference in BMI compared to the reference group was found among Iranian women who immigrated to Sweden in 1989 or later. Our hypothesis that elderly Iranians were less frequently physically active in their leisure time proved to be wrong because there were no significant differences in odds for \geq once-weekly leisure-time physical activity between Iranian-born and Swedish-born individuals.

STUDY II

This collaborative, transnational project gave us the opportunity to compare risk factors for CVD in 176 elderly Iranians of both sexes settled in Stockholm, Kista, with risk factors for CVD in 300 elderly Iranian men and women in Tehran after accounting for age, socioeconomic status, and marital status.

Hypothesis

We hypothesized that there was an association between migration status and the prevalence of risk factors for CVD. The findings of immigrant studies performed in Australia [91, 110] and the United Kingdom [171] led us to hypothesize that CHD (CVD) risk

factors would be more prevalent in elderly Iranian immigrants in Sweden than in elderly Iranians in Iran.

Results

There was a strong association between migration status and CVD risk factors such as hypertension and smoking, and their prevalence was much higher among Iranian women and men in Sweden than among Iranian women and men in Iran. (Table 9). Hypertension was more common among Iranians in Sweden, where more than one third of the women and one half of the men were hypertensive. Furthermore, Iranian men in Sweden had the highest prevalence of smoking of all groups in the study.

Iranian women and men in Sweden had a significantly higher age-adjusted odds ratio of hypertension (ORs = 1.9 and 3.1, respectively) and of daily smoking (ORs = 6.9 and 4.7) than Iranian women and men in Iran. The odds ratios remained significant after adjustment for all variables, including age, education, and marital status (Table 10). There were no differences in the CVD risk factors general obesity, abdominal obesity, or diabetes mellitus.

Table 10. Odds ratios (ORs) with 95% confidence intervals (CIs) of cardiovascular disease risk factors in Iranian-born elderly persons (categorized by length of time in Sweden) vs. Swedish-born elderly persons by sex. Logistic regression. The main model includes all the variables in the table.

Outcomes	Age-adjusted model		Main model	
	Women	Men	Women	Men
Iranians in Iran OR (Reference)	1	1	1	1
Iranians in Sweden				
General obesity				
OR	1.4	0.6	1.5	0.9
(CI)	(0.9–2.3)	(0.2–1.5)	(0.9–2.5)	(0.3–2.8)
Abdominal obesity				
OR	0.9	1.2	0.8	1.5
(CI)	(0.5–1.6)	(0.6–2.6)	(0.5–1.5)	(0.6–3.6)
Hypertension				
OR	1.9	3.1	2.1	3.4
(CI)	(1.1–3.2)	(1.5–6.3)	(1.2–3.6)	(1.5–7.7)
Smoking				
OR	6.9	4.7	7.4	4.9
(CI)	(2.2–21.6)	(2.0–11.0)	(2.2–24.4)	(1.8–13.4)
Diabetes mellitus				
OR	0.8	0.8	0.8	0.6
(CI)	(0.4–1.3)	(0.3–1.8)	(0.6–1.7)	(0.2–1.5)

Table 9. The prevalence (%) of outcomes by migration status, sex, and the independent variables.

Migration status and the independent variables	Category	Obesity		Abdominal obesity		Hypertension		Smoking		Diabetes mellitus	
		Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Iranians in Sweden (n=176)	Total (all 176)	42.0	12.5	77.5	28.6	33.3	50.0	13.0	37.0	21.7	16.1
Age (years)	60–69	38.6	17.2	67.2	27.6	39.7	55.2	5.4	39.3	19.0	24.1
	70–79	44.7	9.1	85.1	31.8	29.8	45.5	15.6	33.3	23.4	9.1
	80–84	46.7	0	93.3	20.0	20.0	40.0	35.7	40.0	26.7	0
Education	> 9 years	40.6	7.7	75.0	25.6	37.5	53.9	10.3	34.2	21.9	23.1
	≤ 9 years	42.5	23.5	78.4	35.3	31.8	41.2	14.0	43.8	21.6	0
Marital status	Married	34.3	14.9	57.1	27.7	40.0	53.2	8.8	35.6	14.3	17.0
	Not married	45.2	0	85.8	33.3	30.6	33.3	14.8	44.4	24.7	11.1
Iranians in Iran (n=300)	Total (all 300)	33.8	19.4	79.2	24.5	21.8	24.5	2.0	11.2	27.4	20.4
Age (years)	60–69	35.0	26.0	81.0	32.0	24.0	28.0	3.0	16.0	29.0	14.0
	70–79	34.8	12.5	78.9	17.5	21.1	20.0	1.1	5.0	28.1	30.0
	80–84	16.7	12.5	66.7	12.5	8.3	25.00	0	12.5	8.3	12.50
Education	> 9 years	26.7	20.8	73.3	20.8	6.7	25.0	6.7	16.7	20.0	16.7
	≤ 9 years	34.4	18.9	79.7	25.7	23.0	24.3	1.6	9.5	28.0	21.6
Marital status	Married	36.1	19.0	79.4	23.2	24.7	25.0	3.1	11.6	29.0	19.0
	Not married	31.7	33.3	79.1	66.7	19.1	0	0.1	0	25.0	66.7

Conclusion

Our hypotheses were confirmed. There was a strong association between migration status and CVD risk factors such as hypertension and smoking. The prevalence of CVD risk factors was much higher among Iranian women and men in Sweden than Iranian women and men in Iran.

STUDY III

Although elderly Iranian immigrants are the largest group of elderly persons in Sweden born outside Europe, little is known about their health-related quality of life (HRQL). The Short Form Health Survey (SF-36) was administered to a total of 625 men and women aged 60–84 years to collect HRQL information on elderly Iranians in Sweden (n=176), elderly Iranians in Iran (n=298), and a randomly-selected control group of elderly Swedish-born people living in Sweden (n = 151).

Hypothesis

We hypothesized that elderly Iranian immigrants in Sweden had lower HRQL than elderly Iranians in Iran because the immigrants lack the broad cultural and linguistic community they would have in their country of origin. Furthermore, based on Findley's theory that elderly persons with poor health are more likely to experience additional health impairment after migration [96], we hypothesized that increased time since migration to Sweden would be associated with lower HRQL. Finally, we hypothesized that elderly Iranian immigrants in Sweden had lower HRQL than elderly Swedes.

Results

The findings in the crude model indicated that Iranian women resident in Sweden a shorter time scored a lower HRQL than Iranian women in Iran on six of eight dimensions of the SF-36. However, only the score for vitality was significantly lower (β -coefficient = -7.9 , 95% CI = -14.3 – -1.5) and remained nearly unchanged after the effect of age and education was added to the main model (β -coefficient = -7.3 , 95% CI = -13.7 – -0.9) (Table 11). Furthermore, longer residence in Sweden was more likely than shorter residence to have a positive effect on all of the SF-36 subscales among elderly Iranian women. Additional analysis showed that these positive effects were statistically significant for social functioning (β -coefficient = 14.1 , 95% CI = 3.1 – 25.1) and role limitation due to emotional problems (β -coefficient = 18.3 , 95% CI = 1.4 – 35.2) and just slightly significant for role limitations due to physical problems (β -coefficient = 14.6 , 95% CI = -0.4 – 29.6) after adjustment for age and education.

However, only the β -coefficients for social functioning and role limitations due to emotional problems were significantly higher in the crude model. The β -coefficient for social functioning remained significantly higher even after adjustment for age and education in the main model (Table 11). Swedish women scored higher on all dimensions of the SF-36 than Iranian women. Swedish men scored higher in physical function, role limitations due to physical problems, general health perceptions, social

functioning, role limitations due to emotional problems and perceived mental health than Iranian men.

Table 11. β -coefficient and 95% confidence interval (CI) for SF-36 dimensions in two models.

Variable	Crude model		Main model (adjusted for age and education)	
	Women	Men	Women	Men
PF				
Iranians in Iran	0 (Reference)	0 (Reference)	0 (Reference)	0 (Reference)
Iranians in Sweden 1989–	-5.1 (-12.7 – 2.6)	2.8 (-7.8 – 13.5)	-3.3(-10.7 – 4.1)	-0.5 (-11.2 – 10.1)
Iranians in Sweden –1988	0.2 (-8.4 – 8.9)	-1.4 (-11.5 – 8.8)	1.4 (-7.3 – 10.0)	-4.4 (-14.5 – 5.6)
Swedes	22.7 (15.7– 29.6)	10.7 (2.2–19.2)	23.6 (16.8–30.4)	10.6 (2.4–18.8)
RP				
Iranians in Iran	0 (Reference)	0 (Reference)	0 (Reference)	0 (Reference)
Iranians in Sweden 1989–	-7.8 (-18.9 – 3.6)	11.7 (-6.0 – 29.4)	-7.5 (-18.7 – 3.6)	2.3 (-15.3 – 19.9)
Iranians in Sweden –1988	9.9 (-2.7 – 22.4)	0 (-17 – 16.9)	7.9 (-5.2 – 20.9)	-7.3 (-23.6 – 9.3)
Swedes	40.4 (30.2–50.5)	19.0 (4.8–33.1)	40.9 (30.7–51.2)	19.0 (5.4–32.5)
BP				
Iranians in Iran	0 (Reference)	0 (Reference)	0 (Reference)	0 (Reference)
Iranians in Sweden 1989–	-6.3 (-14.6 – 1.9)	-1.9 (-14.8 – 11.1)	-7.1 (-15.5 – 1.2)	-6.0 (-9.2–7.2)
Iranians in Sweden –1988	0.16 (-9.2 – 9.5)	-1.1 (-13.3 – 11.0)	-1.8 (-11.6 – 7.9)	-3.6 (-15.9–8.7)
Swedes	18.9 (11.5–26.3)	3.8 (-6.1 – 13.7)	18.8 (1.3–26.3)	3.6 (-6.0–13.3)
GH				
Iranians in Iran	0 (Reference)	0 (Reference)	0 (Reference)	0 (Reference)
Iranians in Sweden 1989–	0.8 (-5.2 – 6.7)	7.7 (-1.6 – 17.0)	0.6 (-5.4 – 6.6)	5.3 (-4.2 – 14.8)
Iranians in Sweden –1988	6.2 (-0.5 – 12.8)	4.1 (-4.6 – 12.8)	5.0 (-2.0 – 12.3)	1.7 (-7.2 – 10.6)
Swedes	21.6 (16.2–27.0)	12.4 (4.8–20.0)	21.4 (16.0–26.9)	13.1 (5.6–20.5)
VT				
Iranians in Iran	0 (Reference)	0 (Reference)	0 (Reference)	0 (Reference)
Iranians in Sweden 1989–	-7.9 (-14.3 – -1.5)	5.9 (-3.1 – 14.8)	-7.3 (-13.7 – -0.9)	3.6 (-5.6–12.8)
Iranians in Sweden –1988	-1.3 (-8.5 – 5.9)	6.4 (-2.0– 14.8)	-1.6 (-9.0 – 5.9)	6.5 (-2.0 – 15.1)
Swedes	21.2 (15.4–27.0)	5.0 (-2.0 – 12.1)	21.2 (15.4–27.0)	3.9 (-3.0–10.9)
SF				
Iranians in Iran	0 (Reference)	0 (Reference)	0 (Reference)	0 (Reference)
Iranians in Sweden 1989–	3.7 (-4.1 – 11.5)	3.6 (-7.6 – 14.9)	4.0 (-4.0 – 12.0)	2.1 (-9.6–13.8)
Iranians in Sweden –1988	18.3 (9.5–27.1)	6.2 (-4.3 – 16.8)	18.6 (9.3–27.9)	4.8 (-6.2– 15.7)
Swedes	34.1 (27.2–41.1)	23.6 (15.0–32.2)	35.2 (28.0–42.3)	23.7 (15.1– 32.3)
RE				
Iranians in Iran	0 (Reference)	0 (Reference)	0 (Reference)	0 (Reference)
Iranians in Sweden 1989–	-5.8 (-18.1 – 6.4)	-5.2 (-23.3 – 13.0)	-8.3 (-20.9 – 3.7)	-8.0 (-27.0 – 10.9)
Iranians in Sweden –1988	14.5 (0.5–28.5)	4.1 (-13.2 – 21.4)	9.7 (-4.9 – 24.2)	1.7 (-16.1 – 19.6)
Swedes	37.5 (26.3–48.7)	21.7 (7.3–36.1)	37.2 (25.8–48.6)	21.7 (7.2–36.1)
MH				
Iranians in Iran	0 (Reference)	0 (Reference)	0 (Reference)	0 (Reference)
Iranians in Sweden 1989–	-3.9 (-9.6 – 1.9)	1.2 (-6.8 – 9.1)	-4.6 (-10.5 – 1.2)	0.8 (-7.5 – 9.1)
Iranians in Sweden –1988	2.5 (-4.0 – 8.9)	3.8 (-3.8 – 11.4)	1.0 (-5.8 – 7.8)	4.1 (-3.7 – 11.9)
Swedes	23.4 (18.2–28.6)	16.7 (10.2–23.1)	22.8 (17.5–28.2)	16.5 (10.0–22.9)

PF = physical functioning, RP= role limitations due to physical problems, BP = bodily pain, GH = general health perceptions, VT = vitality, SF = social functioning, RE = role limitations due to emotional problems, MH = perceived mental health

Conclusion

Our hypothesis was partly confirmed that there was an association between migration status and HRQL, so that Iranian women resident a shorter time in Sweden scored lower for vitality than Iranian women in Iran after adjustments for age and education. Furthermore, longer residence in Sweden was more likely to have a positive effect (higher scores) on social functioning, role limitation due to emotional problems, and on role limitations due to physical problems among elderly Iranian women than among Iranian women with shorter residence. Finally, our hypothesis was confirmed that the mean scores of HRQL for both Iranian groups were lower than those of the Swedish general population in all dimensions among women and in six of eight dimensions among men.

STUDY IV

In this cross-sectional study of 121 Iranians living in Stockholm and 52 Iranians living in Tehran, aged 60–80, dietary intakes were assessed from 2004 to 2006 by a semi-quantitative food frequency questionnaire.

Hypothesis

We hypothesized that there would be dietary differences between elderly Iranians living in Stockholm, Sweden, and elderly Iranians living in Tehran, Iran, after taking into account possible confounders, and that these differences would be associated with higher odds of overweight, general obesity, and central obesity.

Results

Table 12 shows average energy adjusted daily intake of dietary variables among the study population by migration status and sociodemographic and anthropometric characteristics. Both groups consumed almost same amount of macronutrients, protein, carbohydrates, and fat among the BMI categories, while consumption of dairy products was highest among those with $BMI \geq 30$ in both groups.

Iranians living in Sweden had higher intake of protein, total fat, fiber, and all other individual food groups with the exception of bread and grain intake and intake of carbohydrates, which was lower than that of Iranians living in Iran (Table 13). We found only one association between diet and the outcome variables: in those Iranians who had lived in Sweden more than 15 years, there was an inverse association between fruit consumption and central obesity (data not shown).

To avoid collinearity, length of time in Sweden was not included in the models, but further separate analyses that only included Iranians living in Sweden showed that length of time in Sweden was not associated with intake in grams of dietary variables (data not shown). Analysis of a total 20 first-order interactions was simultaneously undertaken in each of the 10 models. The only significant interaction found was between sex and migration status for consumption of vegetables and roots. Iranian women living in Sweden had the highest consumption of vegetables and roots of all groups (data not shown).

Table 12. Average energy-adjusted daily intake of macronutrients, fiber, and selected food items among Iranians living in Iran and Sweden by migration status and sociodemographic and anthropometric characteristics.

Migration status, sociodemographic and anthropometric characteristics	Category	Protein	Carbohydrates	Fat	Fiber	Bread and grain	Vegetables and roots	Fruit	Meat	Dairy	Edible fat
Iranians in Iran (n=52)	Total	67	347	73	10	352	315	221	89	273	29
	Sex										
	Women	66	347	72	12	370	282	267	76	298	32
	Men	68	348	74	8	339	338	189	98	256	26
Education	> 9 years	66	347	73	7	345	292	249	98	307	31
	≤ 9 years	69	348	74	12	359	339	194	81	239	26
Marital status	Married	67	342	76	8	335	322	228	92	295	29
	Widowed	68	380	55	19	455	270	179	70	139	29
Anthropometry	2.5≤BMI<30	67	347	74	8	347	307	193	86	275	29
	BMI≥30	68	348	73	15	335	286	293	78	351	28
Iranians in Sweden (n=121)	Central obesity	69	353	70	12	354	276	259	79	337	29
	Sex										
	Total	83	267	97	26	272	429	442	168	454	52
	Women	84	270	97	28	272	495	449	169	471	54
	Men	81	260	97	22	271	300	430	165	421	49
Education	> 9 years	84	270	94	26	279	437	431	168	449	48
	≤ 9 years	82	265	100	26	265	421	452	168	459	55
Marital status	Married	82	265	97	25	270	448	419	166	414	50
	Widowed	84	269	98	27	274	411	464	170	493	54
Anthropometry	2.5≤BMI<30	82	265	97	26	275	436	425	162	449	49
	BMI≥30	83	265	101	25	249	401	443	166	505	55
Length of time in Sweden	Central obesity	83	272	97	27	259	442	467	166	482	52
	≤15 years	85	264	99	27	262	454	441	173	458	53
	> 15 years	81	271	95	24	284	397	444	161	449	51

After adjustment for sociodemographic variables, there were no significant differences between Iranians in Sweden and Iranians in Iran in odds of overweight, general obesity, or central obesity by dietary variables. However, after adjustment for age, sex, marital status, and education, fruit consumption was inversely associated with central obesity among Iranians who had lived in Sweden > 15 years (Table 13).

Table 13. Regression model β -coefficient* and 95% confidence intervals (CI) for energy-adjusted intake of macronutrients, fiber, and selected food items (linear regression) among Iranians living in Iran† and Sweden‡ by migration status in two models: (1) Sex- and age-adjusted model and (2) Main model also adjusted for education and marital status.

Outcomes	Sex- and age-adjusted model		Main model	
	β -coefficient	CI	β -coefficient	CI
Protein				
Iranians in Iran	0	Reference	0	Reference
Iranians in Sweden	18.5	13.3–23.6	17.9	12.6–23.2
Carbohydrates				
Iranians in Iran	0	Reference	0	Reference
Iranians in Sweden	-83.2	-100.7 – -65.8	-86.4	-104.4 – -68.4
Fat				
Iranians in Iran	0	Reference	0	Reference
Iranians in Sweden	22.7	14.6–30.9	24.6	16.2–33.1
Fiber				
Iranians in Iran	0	Reference	0	Reference
Iranians in Sweden	15.5	11.4–19.6	15.5	11.3–19.8
Bread and grain				
Iranians in Iran	0	Reference	0	Reference
Iranians in Sweden	-69.5	-108.1 – -30.90	-77.4	-117.1 – -37.8
Vegetables and roots				
Iranians in Iran	0	Reference	0	Reference
Iranians in Sweden	97.0	-19.0 – 213.0	120.2	1.6–238.8
Fruit				
Iranians in Iran	0	Reference	0	Reference
Iranians in Sweden	206.6	127.1–286.1	201.2	118.9–283.4
Meat				
Iranians in Iran	0	Reference	0	Reference
Iranians in Sweden	88.5	67.9–109.1	86.4	65.0–107.9
Dairy				
Iranians in Iran	0	Reference	0	Reference
Iranians in Sweden	172.8	83.8–261.7	167.8	70.9–254.6
Edible fat				
Iranians in Iran	0	Reference	0	Reference
Iranians in Sweden	18.6	11.1–26.0	18.9	11.1–26.6

* The reference is given the value of zero so that the value of the β -coefficient corresponds to the difference in grams for all macronutrients, fiber, and food items compared to the reference category. †TLGS. Tehran Lipid and Glucose Study 2005. Iranians living in Iran coded as the reference group for Iranians living in Sweden, ‡Study of elderly Iranians living in Stockholm 2004–2006.

Conclusion

This study confirmed the hypothesis that there were general differences in dietary habits between Iranians living in Iran and Iranians living in Sweden. These include a reduced intake of carbohydrates, in particular bread and grain products, and an increased consumption of total fat, protein, fiber, fruit, vegetables, meat, dairy products, and edible fat among Iranians living in Sweden. These differences remained after accounting for possible confounders. However, we found that dietary habits were not associated with overweight, general obesity, and central obesity – with the exception of high consumption of fruit, which appeared to diminish the risk of central obesity among Iranians who had lived in Sweden > 15 years.

DISCUSSION

MAIN FINDINGS

Iranian women had significantly higher BMI than the reference group, Swedish men, after adjustment for age, education, and marital status; a finding that was in agreement with our hypothesis. The largest difference in BMI compared to the reference group was found among Iranian women who immigrated to Sweden in 1989 or later. Overall, the prevalence of obesity was 42% and 13% among elderly Iranian women and men in Sweden respectively. Our hypothesis that elderly Iranians were less frequently physically active than elderly Swedes in their leisure time proved to be wrong because there were no significant differences in odds for \geq once-weekly leisure-time physical activity in Iranian-born and Swedish-born individuals. However it is important to consider that almost 50% of elderly Iranian women in Study I were physically inactive in leisure time.

There was a strong association between migration status and CVD risk factors such as hypertension and smoking. The prevalence of CVD risk factors was much higher among Iranian women and men in Sweden than Iranian women and men in Iran.

There was an association between migration status and HRQL, such that Iranian women resident in Sweden a shorter period of time (since 1989 or later) scored lower for vitality than Iranian women in Iran after adjustments for age and education. Furthermore, longer residence in Sweden (since 1988 or earlier) had a positive effect on scores for social functioning, role limitations due to emotional problems, and role limitations due to physical problems. Please note that because of the way the measurement instrument was constructed, the higher/better the score, the better the social functioning and the fewer the role limitations. Shorter residence did not have this positive effect. The mean scores of HRQL for both Iranian groups were lower than those of the Swedish general population in all dimensions among women and in six of eight dimensions among men.

This study confirmed the hypothesis that there were general differences in dietary habits between Iranians living in Iran and Iranians living in Sweden. These include a reduced intake of carbohydrates, in particular bread and grain products, and an increased consumption of total fat, protein, fiber, fruit, vegetables, meat, dairy products, and edible fat among Iranians living in Sweden. These differences remained after accounting for possible confounders. However, we found that dietary habits were not associated with overweight, general obesity, and central obesity – with the exception of high consumption of fruit, which appeared to diminish the risk of central obesity among Iranians who had lived in Sweden > 15 years.

COMPARISON WITH OTHER STUDIES

Our findings of a high risk of high BMI among elderly Iranian women in Sweden agreed with a study from Malmö which found that female immigrants from the Middle East were overweight/obese to a significantly higher extent than Swedish-born women [105]. Other data from national surveys from developing countries revealed that obesity

among women is a serious health problem in the Middle East [172]. Another study demonstrated that the prevalence of both total and central fat accumulation rose among Tehranian adults aged 20–80 between 1998 and 2002 [173]. Findings from the TLGS [163] showed that increasing BMI is also a problem among elderly people in Iran. Elderly Tehranian women had a higher prevalence of obesity (36%) than elderly Tehranian men (15%) [174].

Our finding of no differences in leisure-time physical activity did not agree with other studies. For example, a Swedish study that used national survey data revealed that women and men from “all other countries” (including women and men from the Middle East), reported low levels of leisure time physical activity after accounting for education, smoking, BMI, and longstanding illness or disability [175]. A similar Swedish study from Malmö also showed that women and men immigrants from Arabic-speaking countries performed less physical activity than Swedes. The differences may be explained by differences in the age of the study groups. The studies in this thesis included persons aged 60 to 84 years, whereas the other studies included persons aged 20 to 74.

Our observation that the elderly Iranian immigrants had a higher prevalence of hypertension is consistent with the results of a meta-analysis which indicates a clear association between migration to Western society and an increase in blood pressure [176]. This finding also suggests that the migration to a new country and the acculturation process may have accelerated the development of CVD in this aging population. This finding supports the finding of previous studies that increased levels of psychosocial stress due to the experience of migration and cultural adaptation may contribute to hypertension [176].

Moreover, previous and well-known studies of Japanese immigrants to the United States [69] and European immigrants to Australia [91] also provide strong evidence of the influence of environmental and lifestyle factors in the etiology of CVD.

The finding that the elderly Iranian immigrants reported poorer health than Swedes agreed with the finding of other studies that have confirmed that foreign-born elderly individuals report poorer health than native-born elderly individuals [15, 177]. Meanwhile, the fact that elderly immigrant women were not likely to experience worse HRQL with additional years in Sweden is not in accord with the findings of the Findley study [96], i.e., that elderly persons with poor health were likely to experience additional impairment in their health after migration.

Our finding that migration status has an important impact on behavioral factors such as dietary habits agreed with the findings of previous studies on migrants [106, 111, 171, 178]. However, higher dietary intake among Iranians living in Sweden was not associated with overweight, general obesity, and central obesity, a finding that was not in agreement with other studies, which showed that dietary differences after migration make a major contribution to higher prevalences of central obesity [110] and general obesity [171]. One possible reason for the difference in the findings is that these studies focused on younger and middle-aged people, whereas our focus was on elderly immigrants. Our observation of an inverse association between fruit intake and central obesity among Iranians who have been in Sweden > 15 years is consistent with results of a recent Iranian study which indicate that those participants with greater frequency of fruit consumption were less likely to be centrally obese. But this recent study did not include men [179].

POSSIBLE PATHWAYS BETWEEN MIGRATION AND CVD RISK FACTORS

Changes in lifestyle

We think that changes in lifestyle associated with migration may be particularly important for elderly Iranians in Sweden because elderly Iranian men and women in Sweden live longer than Iranians in Iran, and Iranian women live up to 2 years longer than Swedish-born women in Sweden [180]. This increasing average life span prolongs the duration of exposure to risk factors and may increase the risk of clinical CVD events.

There is little doubt that migration can have a negative impact on cardiovascular health. A considerable part of this negative impact may be explained by changes in lifestyle (e.g., physical activity, and smoking) [105, 106] and dietary habits [110, 111]. Negative impact might also result from the migration process itself, which often involves major social and familial changes as well as economic disruption. These factors can cause psychosocial stress and physical disease [181]. However, the observed dietary habits of elderly Iranians living in Sweden seem to represent both the partial adoption of negative Swedish dietary habits such as higher fat intake and positive Swedish dietary habits such as high intake of fruit, vegetables, fiber, and dairy products. Adoption of the negative habits may help explain the high prevalence of overweight and obesity in elderly Iranians in Sweden, as well as the higher levels of hypertension in elderly Iranians in Sweden compared with elderly Iranians in Iran. The positive habits adopted are consistent with the current recommendations of the Swedish Food Administration. The adoption of favorable dietary habits may help explain the unchanged or improved HRQL results in those who lived more years in Sweden. It may also help explain the increased life expectancy found by other researchers [180].

Nutritional transition

The nutritional transition, characterized by a shift from diets high in complex carbohydrates and fiber to those with a higher proportion of fats and sugars, has been accompanied by a shift toward a more sedentary lifestyle. Together, these changes may have contributed to trends toward higher prevalence of obesity and increased risk factors for CVD that appear to be accelerating in developing countries [182]. During a period of rapid globalization and urbanization between 1960 and 2000, the availability of edible vegetable oils and foods with added caloric sweeteners more than doubled in the Middle Eastern countries [182]. Furthermore, during the past 30 years, per capita dietary energy availability has increased from 2000 kcal to almost 3000 kcal per person per day in Iran. [183]. Although older people are more likely to adhere to traditional dietary patterns [184], the growing availability of energy-dense food in Iran may cause excess energy intake. This may be a major factor contributing to the substantially higher BMI values among elderly Iranian women who came to Sweden after 1989 than among those who came before that time, as the women who immigrated more recently may have had greater exposure to the ongoing changes in nutrition and lifestyle in Iran than earlier immigrant women.

Selective migration

The migration process is highly selective regarding health. Not only the accurate screening and detection of existing health problems by the new host country government but also the migration of younger adults is selective of people whose health is better than that of non-migrants [95], whereas poor health may be a reason for migration among older people [95, 96]. In addition, the fact that Swedish authorities do not screen migrants for health before they leave the country of origin, means that elderly immigrants can migrate to Sweden regardless of their health status.

Low vitality among Iranian women with a shorter period of residence in Sweden might reflect the multiple health problems and high prevalence of CVD risk factors among Iranian women in Iran that has been documented in many studies [9, 10, 183, 185, 186]. Moreover, the high prevalence of obesity among elderly Iranian women who recently migrated to Sweden may also explain their low vitality and poor HRQL. However, according to Bentham's theory [95], poor vitality due to a high prevalence of chronic diseases such as CVD might have been a reason why these women migrated to Sweden.

Socioeconomic status

A large majority of the elderly Iranian immigrants in Sweden have only a low pension, as most of them arrived in Sweden after the age of 50. Moreover, elderly immigrant women in this thesis had a lower level of educational attainment than men. Low educational and socioeconomic status may isolate people, particularly women, from resources and knowledge about the disadvantages of a sedentary lifestyle, which in turn can lead to obesity and CVD. Furthermore, social inequalities in self-reported health increase and contribute to health inequalities in early old age. This widening gap in health inequalities will become an increasingly important public health issue, especially as the population ages [187].

It has been discussed whether a poor lifestyle among immigrants may be explained by cultural factors or socioeconomic disadvantage [188]. A study of elderly persons living in Tehran found that the higher prevalence of obesity among women was associated with socioeconomic factors [174]. Food choice might also be influenced by limited economic resources among low-income groups and contribute to fat-rich and energy-dense dietary choices, which are often inexpensive and taste good [189-191].

Acculturation

According to our model approximately 90% were separated from the Swedish language and culture and a few were integrated in both the Swedish and Iranian cultures, which emphasizes that acculturation probably plays an important role in determining elderly Iranian immigrants' HRQL and lifestyle.

Limitations and strengths

The low response rate might have introduced selection bias. However, the response rates, which were about 62% in Study I and 65% in Studies II–IV, are of the same magnitude as those in other comparable studies of immigrants. It is not uncommon that

immigrants leave Sweden without reporting to the authorities. Many elderly immigrants live for long periods of time in their home country [192]. Thus, a number of elderly Iranians either temporarily or permanently no longer resident in Sweden may have remained in the registers and been sent an invitation to participate, making the response rate appear lower than it actually was. Statistics Sweden has estimated total over-coverage for 1997. They estimated that a minimum of approximately 27,000 non-Nordic immigrants have left the country without registering the move. Their conclusion was, however, that the “true” value of over-coverage lies in the interval 25,000–50,000 [193]. A non-response analysis was performed that showed no significant differences between the respondents and non-respondents in the main variables, so it was concluded that non-response had only minor effects on the results.

Another limitation is the cross-sectional design of the four studies, which precludes any causal conclusions. Moreover, many data were self-reported, which means that they represent subjective evaluations rather than objective measures. However, the reliability and validity of the questions taken from the Swedish Annual Level-of-Living Survey, SALLS have been found to be high [160]. Moreover, other studies [141, 161] have shown that the self-reported measures used in SALLS are reliable. However, we took the known discrepancy between objectively measured and self-reported weight and height into account [194].

One might argue, however, that assessing dietary intake in this thesis, like most other dietary surveys which are based on self-reports, can be reliable. For example, the existence of under- and over-reporting of energy intake which is associated with age, sex, BMI, and lifestyle factors such as smoking [73, 74] may misrepresent the result of the surveys. In order to avoid this well known assessment bias in the fourth study, a validation of dietary assessment was undertaken to calculate the degree of under- and over-reporting of dietary intake. The results of the validation process showed that 14% of Iranians living in Sweden were over-reporters and 6% were under-reporters. During the interviews with Iranians living in Sweden, a number of respondents gave the impression that they used their exaggeratedly large remarkably dietary intake to obtain prestige and status. In addition, the foods that this group of participants frequently mentioned consuming were fruit and vegetables, expensive meat products, salmon (considered an exclusive food in Iran) and other seafood. In this study, subjects with over- and under-reporting were excluded in order to make the results as precise as possible.

It is possible that using BMI exclusively as a measure of overweight and obesity is not relevant in elderly persons. Standard BMI guidelines may be too restrictive when they are used to refer to elderly populations [195]. Age-related changes in body composition are accompanied by a progressive increase in the ratio between fat and lean body mass, which is associated with a greater increase in intraabdominal fat than in subcutaneous or total body fat [49]. BMI and total body fat are considered to be significant determinants of CVD risk [196, 197], whereas other studies recommend central fat mass as a significant CVD determinant [99, 198]. Nevertheless, BMI is a widely used and accepted measure for the definition of obesity associated with medical risk in adults [48]. Furthermore, studies have suggested that CVD risk occurs at a lower BMI in Asian populations than in Western populations [195, 199, 200]. In addition, a population-based study in Iran suggested that the cutoff points for BMI measures as indicators of CVD risk are higher for Iranians than for other Asian populations [201].

However, Gu et al. support the use of single common recommendation BMI cutoffs for defining overweight and obesity among all ethnic groups [202].

Comparing data from two different countries that were gathered by different researchers using different sampling and administrative procedures, as was done in Studies II–IV, can lead to variations in validity of data and methodological problems. For example, the definition of DM among elderly Iranians living in Sweden in the second study was based on self-reported data, while the definition of DM among elderly Iranians in Iran was based on fasting plasma glucose and an oral glucose tolerance test, which was given to those who were considered non-diabetic based on FPG [9].

The results of a US study of 3075 elderly people, which was designed to determine the prevalence of undiagnosed DM, showed that existing DM remains undiagnosed in approximately one-third of all older individuals when the WHO criteria are used [203]. An Italian study showed that an oral glucose tolerance test was needed to confirm the diagnosis of DM in elderly subjects with fasting plasma glucose of 126–140 mg/dl [204]. This might explain the lower prevalence of DM among elderly Iranians living in Sweden than in elderly Iranians living in Iran found in Study II. Moreover, the dichotomization of the smoking variable into current smokers (including daily smokers, occasional smokers and those who smoke the hookah) and non-smokers (including former smokers and those who never smoked) is broad and does not permit the identification of moderate and heavy smokers. Furthermore, former smokers often have an increased risk of CVD [205], and therefore, when possible, should not be categorized with those who have never smoked, as it might dilute the results.

Finally, there is a lack of information on important variables such as social, ethnic, and cultural context in this thesis. Although no previous study has documented an association between ethnicity and culture and risk factors for CVD and HRQL among elderly Iranian populations, it seems likely that the lack of information on these variables in the analyses is an important limitation.

Despite these limitations, the present study has several strengths. Even with the small number of the elderly Iranians in Sweden in the current thesis, there was sufficient (80%) statistical power to detect medium-sized effects in Studies I–III. Moreover, the focus of this study was on a homogeneous immigrant group that consisted of elderly people, who had roughly the same kind of background. The well-defined control groups, which represent random samples of the urban population in Iran and Sweden, are also a strength.

The regression models used had the advantage of adjusting for age, socioeconomic status, and marital status, which made it possible to examine the independent association between migration status and CVD risk factors. Furthermore, the interviews with the Iranian immigrants in Sweden were conducted in their native language, Farsi, to minimize the risk of confusion and/or varying interpretations of the purpose of the questions.

Finally, a major advantage of this thesis was the opportunity to determine the differences in dietary habits and risk factors of CVD among elderly men and women with fundamentally the same genetic background living in different environments. To date, most studies have focused on assessing the effects of ethnic differences on risk factors of CVD with little attention to dietary factors, which play an important role in health and especially in the development and progress of CVD.

CONCLUSION AND IMPLICATION

There is a strong association between migration status and the prevalence of CVD risk factors among elderly Iranians living in Sweden. However, length of time since migration to Sweden is not associated with poorer health-related quality of life among elderly Iranians. Adoption of Swedish dietary habits with negative health effects, such as high fat intake, may help explain the high prevalence of overweight and obesity in elderly Iranians in Sweden, as well as the higher levels of hypertension in elderly Iranians in Sweden compared with elderly Iranians in Iran. Adoption of Swedish dietary habits with positive health effects, such as the high intake of fruits, vegetables, fiber, and dairy products may help explain the unchanged or improved HRQL results in those who lived more years in Sweden.

The changing structure of the world population, partly due to the extension of life expectancy, is and will continue to be one of the most important challenges in public health. It is therefore important to increase knowledge about how to encourage optimal health and quality of life among elderly populations with different ethnic and cultural characteristics and from different social classes. The increasing burden of obesity among elderly persons should continue to be the focus of community and primary care studies in order to develop relevant anthropometric measures for the evaluation of health risks, treatment strategies, practical recommendations, and guidelines for weight management in elderly persons. Furthermore, public health strategies for the prevention and treatment of obesity should consider the exceptional diet and physical activity needs of elderly persons as a group, as well as of elderly persons from different cultures. Moreover, there is a need for clinical assessments of HRQL among elderly persons, and especially elderly immigrants with several risk factors for CVD and impaired HRQL, because impaired HRQL independently predicts mortality and CVD-related hospitalizations [112].

Health promotion in the public health care system and interventions aimed at the prevention and treatment of risk factors for CVD such as obesity should include a special focus on recent, elderly female immigrants, the group who exhibited the largest difference in BMI and the lowest score of health-related quality of life compared to the reference groups. Such resources could empower individuals to achieve a lifestyle that includes more physical activity and healthier dietary habits. This could increase health-related quality of life and decrease the risk of developing CVD, especially as regular physical activity clearly attenuates many of the risk factors for CVD, such as hypertension, diabetes, obesity and abdominal-obesity. Treatments and prevention programs that focus on lifestyle changes and are carried out by dietitians, physiotherapists, district nurses, and physicians in primary health care are therefore recommended.

SUMMARY IN SWEDISH

SYFTE

Syftet med avhandlingen var att analysera skillnader i förekomsten av riskfaktorer för kardiovaskulära sjukdomar bland äldre iranier och svenskar i Sverige, samt äldre iranier i Iran.

METOD

Totalt ingick 1212 män och kvinnor i åldrarna 60–84 år i studien. Studie I omfattade 167 iranskfödda och 235 svenskfödda personer bosatta i Stockholm. Utfallsvariabler: body mass index (BMI) och självrapporterad fysisk aktivitet, som analyserades med linjär och logistisk regression. I studie II, bestående av 176 iranier i Stockholm och 300 iranier i Teheran, skattades prevalensen av fetma, bukfetma, hypertoni, rökning och diabetes. Logistisk regression användes för att skatta odds ratios (OR) med 95 %-iga konfidensintervall (CI) för utfallsvariabler. I studie III användes hälsoenkäten SF-36 för att samla in information om hälsorelaterad livskvalitet bland äldre iranier i Sverige (n= 176), äldre iranier i Iran (n= 298) och en kontrollgrupp (obundet slumpmässigt urval) av äldre svenskar i Stockholms län (n= 151). En linjär regressionsmodell användes för att skatta skillnader mellan de olika grupperna efter justering för ålder och utbildning. I studie IV rapporterades födointaget med semikvantitativt livsmedelsfrekvensformulär bland 121 äldre iranier bosatta i Stockholm och 52 äldre iranier bosatta i Teheran. Skillnader i matvanor mellan de två grupperna samt sambandet mellan matvanor och prevalensen av övervikt, fetma och bukfetma analyserades med linjär och logistisk regression.

RESULTAT

I studie I hade iranska kvinnor det högsta BMI-medelvärdet (29.2) bland samtliga grupper. Modellen, som inkluderade en interaktion mellan kön och antal år i Sverige, visade att det inte fanns några signifikanta skillnader i BMI mellan svenska män (referensgruppen) och svenska kvinnor eller iranska män. De iranska kvinnorna hade däremot signifikant högre BMI än referensgruppen efter justering för ålder, utbildning och civilstånd. Den största skillnaden i BMI fanns mellan referensgruppen och iranska kvinnor som flyttade till Sverige 1989 eller senare. Iranier och svenskar hade nästan samma odds för fysisk aktivitet. I studie II var oddset att ha hypertoni och att vara rökare högre bland iranska män och kvinnor som bodde i Sverige än de som bodde i Iran. Oddskvoten var signifikant även efter justering för alla andra oberoende variabler. Nästan 80 % av kvinnorna i båda grupperna led av bukfetma. I studie III skattade iranska kvinnor som hade bott kortare tid i Sverige vitalitet sämre än andra kvinnor i denna studie. Mer än 15 års vistelse i Sverige hade en positiv inverkan på social funktion och emotionell rollfunktion bland äldre iranska kvinnor. I allmänhet hade svenska kvinnor en högre hälsorelaterad livskvalitet i samtliga dimensioner av SF-36

jämfört med kvinnor i andra grupper. Svenska män skattade hälsan bättre i sex av åtta dimensioner jämfört med andra män i denna studie. Studie IV visade att iranier bosatta i Sverige konsumerade mer protein, fett, kostfiber och mera av samtliga livsmedelsgrupper än iranier bosatta i Iran. Det enda sambandet mellan födointag och prevalensen av övervikt, fetma och bukfetma var ett omvänt samband mellan fruktkonsumtion och bukfetma bland iranier som vistats mer än 15 år i Sverige.

SLUTSATSER

Det finns ett starkt samband mellan migration och prevalensen av kardiovaskulära riskfaktorer bland äldre iranier som bor i Sverige. Däremot har en längre vistelsetid i Sverige inte något samband med sämre hälsorelaterad livskvalitet bland äldre iranier. I själva verket kan en längre vistelsetid i Sverige delvis leda till en anpassning till mer fördelaktiga matvanor, ökad hälsorelaterad livskvalitet, färre riskfaktorer för kardiovaskulära sjukdomar och ökad livslängd. Folkhälsoarbete inom vården och åtgärder som syftar till att förebygga och behandla övervikt och fetma bör fokuseras särskilt på äldre invandrare. I synnerhet bör man fokusera på nyligen invandrade äldre kvinnor som hade den största skillnaden i BMI och lägst skattad hälsorelaterad livskvalitet jämfört med referensgrupperna.

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