Cardiovascular risk factors and predicted risk of cardiovascular disease among Sri Lankans living in Kandy, Sri Lanka and Oslo, Norway

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To my late father and my mother

Abbreviations

BMI	Body Mass Index
CHD	Coronary Heart Disease
CVD	Cardiovascular Diseases
DM	Diabetes Mellitus
HDL	High Density Lipoprotein
LDL	Low Density Lipoprotein
MUFA	Mono Unsaturated Fatty Acids
NCD	Non Communicable Diseases
PUFA	Poly Unsaturated Fatty Acids
SCORE	Systematic Coronary Risk Evaluation
USA	United States of America
WHO	World Health Organization

List of papers

Paper I

Tennakoon S, Kumar B, Nugegoda D, Meyer H. Comparison of cardiovascular risk factors between Sri Lankans living in Kandy and Oslo. BMC Public Health. 2010;10(1):654.

Paper II

Sampath U. B. Tennakoon, Bernadette N. Kumar, Randi Selmer, Mohamed J. M. Mikram, Haakon E. Meyer. Differences in predicted cardiovascular risk in Sinhalese and Tamils in Sri Lanka compared to Sri Lankans in Norway. Accepted for publication in Asia Pacific Journal of Public Health on 25th August 2011 (manuscript ID: APJPH -11-Jun-324.R1)

Paper III

Sampath U. B. Tennakoon, Bernadette N. Kumar, Haakon E. Meyer. Differences in selected life style risk factors for cardiovascular disease between Sri Lankans in Oslo, Norway and in Kandy, Sri Lanka (Manuscript)

1.0 Introduction

1.1 An overview of cardiovascular diseases

Non communicable Diseases (NCD), mainly cardiovascular diseases, cancers, diabetes and chronic lung diseases are the leading cause of death globally killing more people than all other causes combined. In 2008 almost two thirds of the deaths were due to NCD, a 36 million out of 57 [1]. Out of these nearly 80% of deaths occur in low and middle income countries with over 50% of them occurring among people less than 70 years old and 29% under 60 years of age [1].

At present Cardiovascular diseases (CVD) are the number one cause of death globally with low and middle income countries being affected disproportionately [2]. Mortality due to CVD was estimated to be around 16 million [3, 4]. Morbidity compared to mortality due to CVD was about 8 times higher [1, 3]. Thus it is clear that survivors of non fatal CVD events pose a greater disease burden.

According to projections for year 2030 the largest increase in number of deaths from CVD will occur in South-East Asia region [2]. According to World Health Organization (WHO) the "negative effects of globalization, rapid unplanned urbanization and increasingly sedentary lives" are fuelling the rapid development of the burden of CVD in low and middle income countries [1]. People of lower socio economic positions are often more vulnerable to the rapidly growing CVD epidemic and they tend to fall sick and die earlier [1]. Since the proportion of people with lower socio economic standards is generally higher in low and middle income countries the burden on the families and societies caring for these people is a great challenge. CVD epidemics in these countries will also slow down the social and economic growth as well [1]. A higher proportion of working age people die in India, Brazil and South Africa in contrast to USA and Portugal due to CVD which emphasizes the effect on the family economics [5]. India is estimated to suffer the biggest loss in productive life years due to CVD in the 35-64 year age group [6]. The combined effect of loss of productive years of life and the burden of chronic diseases on the society and the individual will be made worse by the fact that the world is ageing fast and that about 70% of the elderly live in low and middle income countries [7].

1.2 Risk factors for cardiovascular diseases

Modifiable risk factors for CVD include abnormal lipids, hypertension, diabetes, tobacco smoking, abdominal obesity, general obesity, psychological stress, insufficient physical activity, harmful use of alcohol and unhealthy diet [1, 8, 9]. According to WHO tobacco smoking, unhealthy diet, insufficient physical activity and harmful use of alcohol may act as the primary life style risk factors which gives rise to a large proportion of the disease burden [1]. In the multinational INTERHEART study it was estimated that 9 risk factors (smoking, history of diabetes or hypertension, abdominal obesity, psychosocial stress, little fruits and vegetables, no alcohol intake, little exercise, and raised plasma lipids) contributed to about 90% of population attributable risk of acute myocardial infarction [9].

Abnormal blood lipids is a major cause of mortality due to CVD [1]. They include raised cholesterol, low high density lipoprotein (HDL) cholesterol, raised low density lipoprotein cholesterol (LDL) and raised triglycerides [1, 10-12]. The ratio of total to HDL cholesterol is a predictor of CVD risk [13, 14]. Raised cholesterol is a problem faced by people of both developing and developed nations. Close to one third of ishemic heart disease is attributable to raised cholesterol [1].

Raised blood pressure is one other important factor that contributes to CVD [8, 9]. Raised blood pressure is a risk factor for hemorrhagic and ischemic stroke as well as coronary heart disease [15]. The risk of death from CVD increases with increasing blood pressure continuously [16] . The relative increase in mortality due to CHD among different populations was similar with increasing blood pressure but the absolute risk of mortality due to CHD at any given blood pressure may differ [17]. Treating hypertension may give rise to about a 40% reduction in stroke and about a 15% reduction in myocardial infarction [16]. Global prevalence of hypertension in adults aged 25 and over is 40% and it is estimated to cause about 7.5 million deaths [1]. Higher BMI is associated with higher blood pressure but the association between blood pressure and BMI may differ between different ethnic groups [18].

Diet plays a major role in CVD. High saturated to polyunsaturated fat ratios, trans fatty acids, high salt consumption and low consumption of fruits and vegetables are risk factors for CVD, and it has been estimated to contribute by up to 30% of population attributable risk of Acute Myocardial Infarction [1, 19, 20]. Lowering saturated fats and increasing polyunsaturated and monounsaturated fats are protective against CVD through

improvements in the lipids [13, 20-22]. Low fat and high carbohydrate diets may increase triglycerides and lower HDL cholesterol [20, 21]. Reducing salt intake helps reduce blood pressure [13, 23]. Consumption of fruits and vegetables have been shown to reduce CVD risk [24].

About a billion people are current smokers in the world and the numbers taking up tobacco smoking anew was highest among men from lower middle income countries [1]. Overall the European region had the highest prevalence of smoking for both men and women and the lowest prevalence was found in the African region [1] but in some of the Middle Eastern and North African countries smoking prevalence was very high [25]. When considering China it was as high as 59% in men whereas in Sudan it was only about 12% [8, 25]. Smoking is estimated to cause about 10% of all CVD and close to 6 million people die from tobacco smoking every year through CVD, cancer and other causes [1].

According to WHO insufficient physical activity claims the lives of approximately 3.2 million people every year [1]. Physical activity is an important factor in maintaining good cardiovascular health and is important both for primary and secondary prevention of CVD irrespective of BMI [1, 26, 27]. Prevalence of insufficient physical activity is high in high income countries, but insufficient physical activity is high in some low and middle income countries as well [1, 25, 28].

Obesity and overweight leads to adverse effects on blood pressure, blood lipids and sugar metabolism [1]. It has been estimated that overweight and obesity claims about 2.8 million lives each year and risk of CVD increases with increasing BMI [1]. Over 50% of women in the WHO European region, Eastern Mediterranean region and Region of Americas was reported to be overweight. In the Middle East and North Africa obesity varied between 20% and 51% [25]. Diabetes mellitus prevalence is highest in upper middle and lower middle income countries [29].

Alcohol in moderation is likely to be beneficial in preventing CVD [9, 30]. The effects are through effects on serum lipids and clotting factors [30]. Heavy consumption on the other hand can be harmful [1, 31]. Binge drinking is a serious CVD risk factor and alcohol is also associated with sudden cardiac death and arrhythmias [32]. Apart from CVD heavy consumption of alcohol can give rise to many other health problems [33].

Generally CVD risk factors tend to cluster in individuals rather than presenting as isolated risk factors [34-36]. The overall risk of cardiovascular disease (CVD) is a product of interaction of all the risk factors and may act synergistically to increase the risk many folds [36] Therefore rather than concentrating on single risk factors estimating the total risk a person carries will be more practical in the prevention of CVD. Several models have been developed in order to estimate the absolute risk of Coronary Heart Disease (CHD) and CVD, for example the Framingham and SCORE risk estimation models [37, 38].

CVD in South Asians

Compared to the general population of the world, South Asians appear to be at a higher risk of CVD, judging by the lower age at which they succumb to, severity and predicted risk of and increased rates of the disease according to expatriate and native South Asian studies [39-49]. CVD risk profile of South Asians living in western countries is characterized by low HDL cholesterol, higher triglycerides, comparable total and LDL cholesterol, higher serum insulin concentrations, increased diabetes mellitus and central obesity together with higher rates of myocardial infarctions, re-infarction and higher mortality rates from CHD [40, 43, 50-54]. Even though the LDL concentration may be comparable to others the particle size of LDL is known to be smaller and more prone to oxidative changes that can be harmful among south Asians [55]. Among Gujarat's in UK and India high Triglyceride concentration was also associated with high total cholesterol, low HDL, denser LDL particles and a higher concentration of oxidized LDL [56]. Blood sugar levels in the higher side of the normal range also increases CVD risk in south Asians [53]. Blood pressure differences have not been consistent between the south Asians in UK and Europeans [53, 57]. Different ethnic groups from the Indian subcontinent (i.e. south Asia) have often been grouped together in studies of immigrants and often assumed to be similar; however, there are actually considerable variations in their origins and life styles [58]. Intra-ethnic differences have even been demonstrated within Pakistan, with differences in the prevalence of hypertension among the different ethnic groups [59]. A six fold increase in CVD in urban India compared to a twofold in rural India during the last 4 decades is another example [6]. In Pakistan, differences in the prevalence of major risk factors among urban, rural and between different social groups have been shown, with more affluent groups showing higher prevalence rates than lower classes [60]. Better socio-

economic standards on the other hand played a protective role with regards to certain risk factors in India [61].

At present South Asia is experiencing a rapid increase in CVD prevalence where urban areas and sometimes upper social classes seem worse off [6, 45, 59, 60, 62-65].

Diabetes Mellitus (DM), a risk factor for CVD, is projected to show the greatest increase in the Indian subcontinent and Asia [43]. South Asians are prone to have higher levels of visceral fat, lower muscle mass and also a higher percentage of body fat [66]. The cut offs for high waist circumference for example has been lowered for south Asians compared to Caucasians [43].

South Asian dieatray insufficiencies, namely low intake of mono unsaturated fatty acids (MUFA), n-3 poly unsaturated fatty acids (n-3 PUFA) and fibre and high intake of saturated fats, carbohydrates and transfatty acids are also blamed for insulin resistance, dyslipidemia and sub clinical inflammation among them [67]. A diet rich in refined carbohydrates and saturated fats may contribute to the worsening burden of CVD and diabetes [20, 45, 67]. Coconut fat (close to 85% saturated) is the major source of fat for Sri Lankans supplying on average 25% of daily total energy intake [20, 68].

Smoking of tobacco in the form of cigarettes or beedi too is on the rise in south Asia [43] and smoking was an important risk factor for myocardial infarction among south Asians as reported by Pais et al [69].

Guptha et al has shown that physical activity was lower in the more educated groups in India compared to others where inactivity was as high as 70% [65]. Controls in a case control study excercised more (48%) compared to cases (38%) of myocardial infarction in India [70]. Another study comparing cases and controls of acute myocardial infarction from 5 centers in south Asian countries with cases and controls from other countries, reported physical activity among south Asians to be lower [48]. Physical activity among south Asians in UK was much lower than among Europeans [71].

In Sri Lanka Coronary Heart Disease was a leading cause of hospital mortality and of hospital admissions in 2006 [72]. Studies on CVD and risk factor prevalence in the country are limited. One study found rural urban differences with higher prevalence of hypercholesterolemia, diabetes mellitus and higher body mass index among urban dwellers

[45, 63]. A study in a sub-urban area of Colombo found similar total cholesterol, HDL, triglycerides, systolic and diastolic blood pressure, BMI and waist to hip ratio among men and women. The study reported increasing prevalence of most risk factors over ten years in the same area, and high levels of abdominal obesity in spite of lower general obesity [45]. A study comparing four different provinces of the country showed that almost half the population was overweight (BMI >23 kgm^{-2}) by WHO new criteria for obesity in South Asia [73]. Women had a higher BMI, where the highest was in the Western province, the more affluent and the lowest was in the North Central, a less affluent province and men in the Western province had the highest waist to hip ratios [73]. Social class as determined by income and education may be playing a role in the differences as varying income and educational levels are described for the four provinces

Migration

Migration of populations between and within countries is not a new phenomenon. Millions of people migrate for various reasons including for socio-economic prosperity and safety issues in home countries or regions. The healthy migrant hypothesis suggests that migrants are generally healthier than the general population of the host country [74]. The selective migration hypothesizes that the migrants are a group of healthier people to start with compared to the general population of the country of origin [74]. The convergence hypothesis is tied to assimilation policies which assumes that the migrant will integrate in to the host society where even health status will converge on to a one similar to the host society [74] which, has been observed in migration studies [75-77]. Assimilation is the process by which a migrant is adapted to the new culture where he or she is expected to give up all or most of his culture. Integration is where there is acceptance of the migrant in to the host society with a give and take attitude [74]. In Norway migrants are encouraged to integrate in to the Norwegian society. Close to 12000 Sri Lankans live in Norway, most living in the Oslo area.

Sri Lankan migrants in Oslo were reported to have lower HDL cholesterol and higher triglycerides compared to Vietnamese, Iranians and ethnic Norwegians [78]. Sri Lankan and Pakistani women in Oslo were also found to have the highest proportion of central obesity and both men and women from Sri Lanka and Pakistan had higher Waist to Hip

ratios for any given BMI compared to other immigrant groups [79]. On the positive side, the Sri Lankans had the lowest prevalence of smoking

1.3 Rationale

South Asians who live in western nations have been found to have high prevalence of certain risk factors for cardiovascular diseases compared to Caucasians. Studies on south Asians in developed countries have traditionally grouped them together as one homogenous group. But there are considerable differences in their origins and life styles [58]. Intra-ethnic, urban-rural and social class differences have been demonstrated within Pakistan and India [60, 61, 80, 81]. The INTERHEART study findings suggest the need for risk factor profiling of different ethnic groups [9].

Previous studies from Sri Lanka have not looked at ethnicity. Apart from that no studies comparing expatriate Sri Lankans living in developed countries with host country populations or with those living in Sri Lanka were found when this thesis was initiated.

1.4 Objectives

Main objectives:

To assess the prevalence of selected risk factors for cardiovascular disease in Sri Lankans living in Sri Lanka and compare them with Sri Lankans living in Oslo, Norway.

Specific objectives:

To compare Sri Lankans in Oslo Norway with urban Tamils and Sinhalese in Kandy, Sri Lanka with respect to:

Selected risk factors for cardiovascular disease

The association between obesity and other cardiovascular disease risk factors as well as their association with socio-demographic factors.

The predicted risk of CHD (Framingham risk) and fatal CVD (SCORE risk)

Selected dietary and other life style risk factors with special focus on indicators of dietary fat consumption

2.0 Methodology

Study design

Cross sectional community based studies

This thesis consists of data from cross sectional community based studies conducted in Oslo, Norway and Kandy, Sri Lanka. Since the objectives of the studies were to measure the prevalence of selected risk factors for cardiovascular disease and to look for associations between them, cross sectional study design was appropriate.

The information obtained from cross sectional studies refers to a point in time. They are basically "snap shots" of the population status with regard to disease or exposure [82]. Cross sectional studies measure the prevalence of disease and are often called prevalence studies.

Study population

The study population comprises of three groups from four health studies: Sri Lankans in Oslo and Tamils and Sinhalese of Kandy.

Sri Lankans in Oslo, Norway

We included data from participants born in Sri Lanka between 1940 and 1971 participating in the population based, cross sectional Oslo health study (HUBRO) and the similar Oslo immigrant health study conducted between 2000 and 2002 [78, 83].

HUBRO

HUBRO was conducted in Oslo Norway from May 2000 to September 2001 by the Norwegian Institute of Public Health, the University of Oslo and the Oslo municipality (available at http://www.fhi.no/tema/helseundersokelse/oslo/index.html.). All men and women born in 1924, 1925, 1940, 1941, 1955, 1960 and 1970 living in Oslo were invited.

(At the end of HUBRO, the invitation was expanded to include persons born in 1954 and 1969. They are not included in the current studies as no reminder was sent to them).

The Oslo Immigrant Health Study

The population based, cross sectional Oslo immigrant health study conducted by the Norwegian Institute of Public Health and the University of Oslo between February and November 2002, has been described earlier (available at http://www.fhi.no/artikler/?id=53584).

The study included all individuals born in Sri Lanka, Turkey, Iran and Vietnam and a 30% random sample of those born in Pakistan, between 1942 and 1982 except 7 birth cohorts (1940/41, 1954/55, 1960, 1969/70) who had already been invited to the HUBRO study.

The cohort was further divided in to the main adult cohort born in the period 1942 to 1971 and the younger cohort born 1972 to 1982. Here we deal with the main adult cohort only.

The data from the two studies were combined, restricted to persons born between 1940 and 1971.

Invitation and recruitment (both studies in Oslo)

Following approval from relevant authorities all were invited through a postal invitation package. The package contained an invitation to participate indicating the time and place of appointment, a three page questionnaire (appendix 1), instructions on how to fill the questionnaire, a letter of consent to be handed personally at the screening, an information brochure and a map showing the exact location of the screening.

The questionnaires were translated into Turkish, Farsi, Urdu, Tamil, and Vietnamese, except for the supplementary questionnaire in the Oslo Immigrant Health Study (which was only available in Norwegian and English). At the screening station, field workers speaking the above five languages were available.

In HUBRO up to two reminders were sent to non-responders, whereas one reminder was sent in the Oslo Immigrant Health Study. Among Sri Lankans, the response rate was 50.9% in the Immigrant study and 50% in the HUBRO study. However, the response rate to the

supplementary questionnaire was only 40% among the Sri Lankans. A majority (99%) of Sri Lankans in the immigrant health study had indicated Tamil as their mother tongue.

Sinhalese and Tamils of Kandy, Sri Lanka

I and coworkers performed two studies in Sri Lanka, one including Sinhalese and one including Tamils, between the ages of 30 and 60 years, in order to compare with the Oslo group of Sri Lankans.

Population of Sri Lanka

Sri Lanka is a small island nation, with a land area of 65000 square Km situated about 30 Km from the southern tip of India, supporting a population of approximately 20 million [84]. Sri Lanka is multi cultural, with a predominance of Sinhalese amounting to 74.5 % of the population (Table 1).

Table 1. Population distribution by ethnicity

Ethnicity	Percentage
Sinhalese	74.5
Tamil	16.5
Moor (Muslims)	8.3
Malay, Burgher, other	0.7

Source-Department of census and statistics Sri Lanka **[84]**

Study area and population-the Kandy Municipal council area

The study was carried out in the Kandy Municipal council area of the district of Kandy which is situated in the Central Province of Sri Lanka. The multi ethnic 110,000 population living within municipal council limits of Kandy is defined as an urban population. Out of this 80300 are Sinhalese and 14328 are Tamils (66% of them are Sri Lankan Tamil).

Kandy municipal council area is divided in to 43 grass root level administrative areas known as Grama Niladari areas, each with a population of about 2500.

Sampling frame - The electoral registers

Electoral registers maintained by the Department of Elections in which Sri Lankans above the age of 18 years are usually registered is one of the most important population registers. The list is updated every year by the relevant authorities. Registration is not mandatory by law. Being registered is beneficial since it can be used to verify one's area of residence apart from the right to vote at elections. No information on how complete the lists were found. The list records name, address and sex by households but does not record the age or the date of birth. We used these registers prepared for the year 2004 as our sampling frame. Previous studies from Sri Lanka have used the register as the sampling frame [63, 64].

Close to 66% of the total population of the country was over eighteen years old [84]. Therefore expected number of adult Sinhalese registered in the Electoral List would approximately be 53000 (66% out of 80300) and adult Tamils about 9500 (66% out of 14328). Since age or date of birth is not registered, we had no way of verifying age at the random selection stage. Therefore we decided to verify age at the stage of recruitment and exclude those above 60 and below 30 years in age.

Tamils study, August to December 2005

Sampling frame

All Tamils between the ages of 30 and 60 years registered in the 2004 electoral list and residing within the Kandy Municipal council limits were included in the universe for sampling.

Sample size

We assumed that the risk factor with the lowest prevalence, hypertryglyceridaemia (Triglycerides > 2.25 mmol/l), would be around 8% based on a study in Colombo, Sri Lanka where the prevalence of hypertryglyceridaemia was 8.9% [45].

Based on the above assumption, for a prevalence of 8% of high triglycerides to achieve a precision of 8±3% prevalence at 95% confidence interval a minimum sample of 299 was required as calculated using the "statistical calculator (Statcal) of the "EpiInfo 2002" statistical program.

Since we were not aware of the percentage of the population falling within the target age group out of those registered we inflated the sample size by 50% increasing the number necessary to contact to 450. We also decided to include equal numbers of men and women.

Simple random sampling

Ethnicity of a person was not indicated in the electoral list which posed a challenge to us. Therefore we used the family name as registered in the lists to identify Tamils. Family name is generally distinct between Tamils and Sinhalese and Moors and Burgers and Malays. All Tamils identified by the family name were then assigned a number, men and women separately, starting from page one of the relevant section of the electoral list to the last. Of these we randomly selected 450 persons by generating random numbers using the Microsoft Office Excel program.

Recruiting and training research assistants

Data collection was carried out by me and a male third year medical student and a female awaiting tertiary education following completion of secondary education. They were both competent in English, Tamil and Sinhalese, the three official languages of the country. They were briefed on the purpose of the study and methods used and trained on conducting the interviews and carrying out the physical examination. During the training we gave special consideration to possible questions from the public regarding discrimination against other ethnic groups, especially considering the prevailing situation of the country at the time, stressing the non biased scientific basis of the study.

Recruiting the subjects

All selected were invited individually following verification of age at house visits. Those above 60 years and below 30 years were not invited. As the Electoral list used to select the sample was from 2004, we expected some of those selected to have moved or died during the year. If a person did not live at the address listed at the time of our visit or was not contactable after three attempts, he or she was dropped from the random list.

Participants

Due to time constraints we only managed to attempt to contact 399 out of 450 on the list. Out of the 201 men and 198 women we attempted to contact, 16 men and 9 women were not contactable or had moved from the address. 9 men and 17 women were over the age of 60 years. 37 men and 31 women were under 30 years of age. Consequently, a total of 139 men and 141 women were invited, of which 103 men (74.1%) and 130 women (92.2%) took part in the study (Table 2).

42% of the subjects were interviewed and examined in their own homes while the rest (58%) were invited out to a home of a neighbor, in their own neighborhood for the interview and examination.

Table 2. Participants – Tamils study

	Men	Women
Total invited	139	141
Total participated	103	130
% of total participated by total invited	74.1%	92.2%

If including the 16 men and 9 women dropped from the list in the denominator, the participation rate would only be moderately lower (men: (103/155)*100=67%, women: (130/150)*100= 87%)

Sinhalese study October 2008 to April 2009

Sampling frame for the Sinhalese study was also the electoral list of 2004. We expected approximately 53000 Sinhalese above the age of 18 years to be registered in the electoral list as has been explained. They would be spread around in all 43 grama niladari divisions of the area. Attempting to contact 600 out of them from throughout the area would have been time and resource consuming. Therefore we decided to use a multistage random sampling method where we would select 50% of the GN divisions in stage 1 and select the sample from each of them, proportionate to the population.

Sample size

As was calculated in the Tamils study the minimum sample required was 299. We decided to double the sample size to 600 (300 men and 300 women) to accommodate design effect that may arise due to multi stage sampling. As we experienced from the Tamils study, only about 60% of those registered in the Electoral lists could be expected to fall within the specified age group. Therefore to maximize sampling, sample size was inflated by 66% which brings the sample size required to be contacted to a 1000. We further inflated the number by 100% leaving room for those who may have migrated out of the area or passed away since the register we used was from 2004. Therefore the final number required to be contacted was 2000.

Multi stage sampling

Stage 1

We selected 22 (51%) of the Grama Niladari divisions in stage 1.

Stage 2

In order to give an equal chance for each and every person to be included, an equal proportion from each of the selected GN divisions was selected. Since the expected population registered in the list living in the 22 divisions was about 24000, the proportion to be contacted was approximately 8.5% of the population from each Grama Niladari division.

Recruiting and training research assistants

Apart from me, the same medical student participating in the Tamil study data collection (who was by this time a qualified doctor), a second male doctor and a female graduate in social sciences were recruited as data collectors. All three were conversant in Sinhala and the two doctors were also conversant in English. They were briefed on the purpose of the study and methods used and were trained in collecting data and carrying out the physical examination.

Recruiting the subjects

We set out to invite all selected individually following verification of age at house visits as has been explained in the Tamils study methodology. If a person did not live at the address listed at the time of our visit or was not contactable after three attempts, he or she was dropped from the list

Participants

Although our plan was to contact all of those selected from the 22 divisions we managed to attempt to contact only 837 from 11 of the grama niladari divisions. Out of the 385 men and 452 women attempted to contact, 38 men and 36 women were not contactable or had moved from the address. 17 men and 34 women were over the age of 60 years. 55 men and 80 women were under 30 years of age. A total of 275 men and 348 women were invited to

take part in the study. Out of them 143 men (52%) and 302 women (86.8%) took part in the study (Table 3). All of the subjects were interviewed and examined in their own homes.

Table 3. Participants-Sinhalese study

	Men	**Women**
Total invited	275	348
Total participated	143	302
% of total participated by total invited	52.0%	86.8%

If including the 38 men and 36 women dropped from the list in the denominator, the participation rate would only be moderately lower (men: (143/313)*100=46%, women: (302/384)*100= 79%)

Table 4. Variables

Variables	Method of verification		Scale of measurement
	Oslo	**Kandy**	
Age	Population register	Electoral lists	Continuous (Years)
Sex	Population register	Electoral lists	Dichotomous
country of birth/Ethnicity	Population register	Name/verification at recruitment	Categorical
Level of education	Questionnaire	Questionnaire	Continuous (Years)
Smoking habits	Questionnaire	Questionnaire	Dichotomus
chronic illnesses	Questionnaire	Questionnaire	Dichotomus
Physical activity	Questionnaire	Questionnaire	Categorical/Ordinal
Dietary habits	Questionnaire	Questionnaire	Categorical/Ordinal/Frequency of consumption
Blood pressure	Examination	Examination	Continuous (Millimeters of mercury)
Height	Examination	Examination	Continuous (Centimeters)
Weight	Examination	Examination	Continuous (Kilograms)
Waist circumference	Examination	Examination	Continuous (Centimeters)
Total cholesterol,	Serum analysis	Serum analysis	Continuous (Milimols per liter)
HDL cholesterol	Serum analysis	Serum analysis	Continuous (Milimols per liter)
Triglycerides	Serum analysis	Serum analysis	Continuous (Milimols per liter)

Data collection

Data collection in the Kandy studies followed the Oslo study with a similar protocol. In Oslo, participants completed a questionnaire, with or without assistance, while participants in Kandy were interviewed using a structured questionnaire.

In Oslo, the questionnaires developed were based on previously conducted studies in Norway, existing scientific knowledge and current needs and priorities of researchers. A pilot study of the main questionnaire (common for both HUBRO and Oslo Immigrant Study) was carried out before HUBRO started (appendix I). The main questionnaire was identical for both studies in Oslo. Methodology of the HUBRO (available at http://www.fhi.no/artikler/?id=53584) and Immigrant study (available at http://www.fhi.no/tema/helseundersokelse/oslo/index.html.) has been published in detail before.

Most of the questions in the Kandy studies were directly imported from the Oslo study, which had already been completed before the Kandy studies. However, the questionnaire was adopted to fit the local context where some of the questions were modified to make them more culture appropriate (appendix II). Most of the modifications were done in the food section of the questionnaire. It was first used in the Kandy Tamil study. The questionnaire was further modified for the Kandy Sinhalese study based on the experience from the Tamil study (appendix III). Analysis of such questions posed a challenge since they were not directly comparable to Oslo, and we had to rely on somewhat similar data from the supplementary questionnaire (appendix IV) of the Oslo Immigrant Health Study. In paper III (page 5) we discuss these data extensively. The supplementary questionnaire of the Immigrant Study can be found at http://www.fhi.no/artikler/?id=28217.

In all studies years of education, personal history of chronic diseases, medication and smoking habits were recorded using similar questions. The Norwegian population register provided information on age and gender and country of birth considered as the country of origin. In the Oslo Immigrant Health Study a cross check with Statistics Norway's registers confirmed that in 99.8% of the cases country of birth was identical to the "country of origin"(http://www.fhi.no/artikler/?id=53584). In Kandy date of birth was recorded at the interview while gender was provided by the electoral list.

Leisure time physical activity was assessed in a four graded question in all studies (paper III page 5)

Frequency of use of alcohol was assessed through a question on how often they consumed alcohol during the last year with the alternatives ranging from never to daily consumption (paper III page 5).

Body weight and height were measured with an electronic height and weight scale in Oslo and a Salter medical scale and a Statometer in Kandy, with the participants wearing light clothing without shoes. BMI (kg/m^2) was calculated based on the measurements. Waist circumference was measured with the subject standing and breathing normally to the nearest 0.1 cm with one and the same steel measuring tape used in all 4 studies. Please confer the discussion, page 33, for the comparability of these measures in Oslo and Kandy

Systolic and diastolic blood pressures were measured three times at one-minute intervals by an automatic device (DINAMAP) in Oslo and with a mercury sphygmomanometer in Kandy. The mean of the last two recordings were used. Hypertension was defined as systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg or being on blood pressure lowering drugs [78].

Non-fasting blood samples were collected and serum total cholesterol, serum HDL cholesterol and serum triglycerides were measured directly by an enzymatic method at the Department of Medical Chemistry, Oslo University Hospital, Ullevål, Norway which was the reference laboratory (Hitachi 917 auto analyzer, Roche Diagnostic, Switzerland) and lab 2 (ESPEE laboratory Kandy Sri Lanka =COBAS MIRA 36-3122 auto analyzer) and at lab 3(Osro lab Kandy -Vitros 250 Auto analyzer) in the Tamils and Sinhalese respectively. Total cholesterol of ≥ 6.2mmol/l, , High Total to HDL cholesterol ratio ≥ 4.4 and High Triglyceride ≥2.7mmol/l were defined as high and HDL ≤0.9mmol/l was defined as low [78]. Cross calibration between the labs is described below.

Data entry

Data was entered in to an electronic format. A random sample of 200 HUBRO questionnaires were double checked for accuracy and showed 99.9% correspondence. A

10% sample of Kandy questionnaires were also double checked and showed 99.9% correspondence.

Ethical considerations

Free and informed consent was obtained from each and every participant. The Higher Degrees and Research Ethics committee of the University of Peradeniya, Sri Lanka approved both studies in Kandy. HUBRO and the Oslo Immigrant Health Study were approved by the Norwegian Data Inspectorate and cleared by the Regional Committee for Medical Research Ethics.

Data analysis

Combined data were analyzed by SPSS version 16 using linear regression and UNIANOVA to adjust all variables for age. Some of the variables were also adjusted for education. Triglycerides were also adjusted for time since last meal. Regression analyses assumptions (linearity and similar variance over different levels of the dependent variable) were checked by inspecting plots of residuals against predicted values. Mixed model analysis was used to look for cluster effects in the Sinhalese study.

Framingham risk-CHD event

Predicted 10 year risk of a CHD event was assessed by Framingham risk as published by Anderson et al in 1990 [37]. We used systolic blood pressure, total to HDL cholesterol ratio, sex, diabetes, smoking and age as the predictor variables. Framingham risk estimation has been dealt with in detail in paper II (page 7)

SCORE risk-fatal CVD

The high risk SCORE algorithm including total cholesterol to HDL cholesterol ratio was used to calculate 10 year risk of a fatal CVD event.[38, 78] We included age, sex, and serum total to HDL cholesterol ratio, systolic blood pressure and current smoking in the model. SCORE risk estimation is further discussed in paper II (page 7).

Lipid analyses

We used 3 different laboratories to perform serum lipid analysis in this study (table 5). Laboratory 1 where the samples of the Oslo studies were analyzed was defined as the reference lab and results from the other two labs were calibrated to the reference lab results. Lab 2 in Kandy was where the samples of the Tamil study were analyzed. Lab 3 was where the samples of the Sinhalese study were analyzed.

Table 5. Lipid analyses and cross calibration

Laboratory		Study	Cross calibration
Department of Medical Chemistry, Oslo University Hospital, Ullevål, Norway	Hitachi 917 auto analyzer	HUBRO/Immigrant HUBRO	Reference lab
Espee laboratory Kandy, Sri Lanka	COBAS MIRA 36-3122 auto analyzer	Tamils study	Cross calibrated to the reference lab standards
OSRO laboratory Kandy, Sri Lanka	Vitros 250 Auto analyzer	Sinhalese study	

In the Kandy studies, blood samples were collected in to plain 8 ml tubes and transported in cold boxes to a laboratory of the faculty of Medicine, Peradeniya within 2 hours of collection. At the laboratory serum was separated by centrifuging the samples at 6000rpm for 5 minutes. The separated serum was divided in to 3 separate 1 ml aliquots and stored at minus 70 ^{o}C freezers.

One aliquot out of the 3 from the Tamil study was analyzed at lab 2 in Kandy between august and December 2005. They were analyzed in 3 batches while data collection was proceeding.

All samples from the Sinhalese study were analyzed at lab 3 in Kandy in 2009.

Cross calibration of lipid analyses

All cross-calibrations were done utilizing serum samples from the Tamil study in 2005. One of the three aliquots from that study was transported to Oslo, Norway on dry ice by express air freight in early 2006. 14 samples out of this aliquot were re-analyzed at the reference laboratory in Oslo for cross calibration purposes. The aliquot was then stored in Oslo. Due to an unexpected drift in lab 2 for total cholesterol (see under), we decided to reanalyze as many as possible of the sampled from the Tamil study stored in Oslo. 182 samples were therefore re-analyzed at the reference laboratory in 2009 which included 8 of the original 14 analyzed at the reference lab in 2006.

In order to compare between the reference laboratory and lab 3, Kandy, 31 samples selected randomly from the Tamil study were analyzed at lab 3 in 2009. They had also been analyzed at the reference lab.

We did extensive data analyses including inspection of graphs (incl. Bland-Altman plots) and regression analyses giving the following results:

Cross-calibration, total cholesterol, lab 2 and reference lab

Inspecting a scatter plot of total cholesterol versus increasing serial number (which was the consecutive number given to the participants) suggested a drift in lab 2. Based on the 182 samples re-analyzed at the reference lab in Oslo, we decided to group the sample into serial number ≤150 (group 1) and > 150 (group 2).

The following regression equation was used for group 1:

Total cholesterol = total cholesterol lab 2 + 1.026 + (-0.006*serial number)

Since the difference between the labs was constant for group 2 the following equation was used:

Total cholesterol = total cholesterol lab 2 – 0.5061

Cross-calibration, HDL cholesterol, lab 2 and reference lab

There was also a drift for HDL cholesterol (but not with a cut point of serial number 150). The difference between lab 2 and the reference labs was best fitted with a linear relation estimated by linear regression:

The following equation was used:

HDL= HDL lab 2 - 0.431 + (0.002*serial number)

Cross-calibration, total cholesterol, lab 3 and reference lab

We used the results of 31 samples from the Tamil study analyzed at both lab3 and the reference lab.

We found a significant difference in the mean cholesterol between the two labs, which was constant across serial numbers

The following equation was used:

Total cholesterol = Total cholesterol lab 3 + 0.48

Cross-calibration, HDL cholesterol, lab 3 and reference lab

HDL from lab 3: Good agreement with reference lab. No correction required

Cross-calibration, triglycerides

Triglycerides from lab 2 and lab 3: Good agreement with reference lab. No correction required.

3.0 Results and conclusions

Paper I

Results: Men and women in Oslo had higher HDL cholesterol. Tamil men and women in Kandy had higher Total/HDL cholesterol ratios. Mean waist circumference and body mass index was higher in Oslo. None of the women smoked. Smoking among men was low (19.2% Oslo, 13.1% Kandy, P=0.16). Although different methods hampered the comparison, mean systolic and diastolic blood pressure was considerably higher in Kandy than in Oslo.

Conclusions: This comparison showed differences in risk factors between migrant Sri Lankans living in Oslo and Tamils living in Kandy Sri Lanka. Sri Lankans in Oslo, although more obese, had more favorable lipid profiles and lower blood pressure.

Paper II

Results: We found that Sri Lankans in Oslo had significantly lower Framingham coronary heath disease (CHD) risk. Among men, the prevalence with estimated 10-year risk of a CHD event ≥ 10% was 20.6% in Oslo, 31.1% in Kandy Tamils and 44.2% in Kandy Sinhalese. The corresponding figures in women were 10.4% in Oslo, 19.2% in Tamils and 14.9% in Sinhalese. Risk of fatal CVD estimated by the SCORE model showed a similar pattern. The Oslo group had a higher Body Mass Index (BMI), but the differences were observed in all BMI categories.

Conclusions: In conclusion, despite a lower BMI, Tamils and Sinhalese in Sri Lanka had higher predicted cardiovascular risk compared to Sri Lankans in Norway, mainly due to poorer lipid profiles.

Paper III

Results: Sri Lankans in Oslo were consuming more soft/light margarines and less coconut fat compared to Kandy. They also reported more physical activity during spare time. Vegetable and fruit consumption in Oslo was lower. Tamil men reported the lowest alcohol consumption frequency. Alcohol consumption among women was negligible in all groups.

Conclusions: Type of fats consumed in Oslo might be a protective factor for Oslo Sri Lankans compared to a predominantly saturated fat diet which appears to be low in polyunsaturated fatty acids (PUFA) in Kandy. Higher physical activity levels may also be protective for Oslo Sri Lankans. Consuming vegetables and fruits at a higher frequency may confer protection to those living in Kandy.

4.0 Discussion

A comparison of selected cardiovascular risk factors and predicted CHD and CVD risk between expatriate Sri Lankans, mainly of Tamil origin, living in Oslo, Norway and Tamils and Sinhalese living in Kandy Sri Lanka was carried out based on data from already concluded cross sectional epidemiological studies conducted in Oslo, Norway and new data collected in Kandy Sri Lanka. In Oslo, the Oslo immigrant health study and the HUBRO study conducted between 2000 and 2002 provided the data. In Kandy two studies were conducted in 2005 and 2008 based on the methods of the Oslo studies. The approach in Kandy was adjusted to suit the local context with some changes in the questionnaire and method of administration. Most of the data were directly comparable although some of the data were not, due to methodological deficiencies.

All three studies used the cross sectional study design. Cross sectional studies collect all the data one and the same point in time thus they allow establishing associations but not causal relationships which is an inherent weakness of the design [82, 85]. Cross sectional studies provide data on prevalence of diseases and risk factors. Since the objectives of the study were to compare the prevalence of risk estimates and risk factors between populations studied, the methodology used here is appropriate but a low response rate may give biased prevalence estimates with this design [82]. On the other hand a longitudinal study comparing those who migrated and those who stayed back in the home country would be better in order to study any causal relationships [85] . Further, a randomized controlled trial would have been the best methodology to establish causative relationships if that was the objective, but would not be feasible for an international migration study.

The results of the study are presented in three papers of which, 1st has already been published, 2nd has been accepted for publishing and the 3rd is in the form of a manuscript. In paper I, we compared serum lipids, blood pressure, BMI, waist circumference and smoking between Sri Lankans in Oslo and Tamils in Kandy. In paper II we compared the predicted risk of incident CHD by the Framingham risk estimation method and the risk of a fatal CVD by SCORE risk estimation methods. In paper III selected dietary factors, alcohol consumption, smoking and spare time physical activity were compared between the three groups as possible explanatory variables for the differences observed between the groups presented in papers I and II. This study is the first migration study targeting Sri Lankans living in their home country and a group that has migrated to a western country. There

were strengths and weakness in the study which have been discussed in the papers and in the following:

4.1 Internal validity

The main focus of thesis was describing the prevalence of CHD/CVD risk factors and factors associated with them between three groups of Sri Lankans. Some of the associations elicited might not be real as they may have arisen due to two types of errors that afflict epidemiological studies. They are random errors and systematic errors [82].

Random errors give rise to variability of data which are handled by optimizing the sample size through power calculations. P-values and 95% confidence intervals were used to test the likelihood of random error. A larger sample would have increased the power to detect smaller differences in risk factors, and the small sample size in Kandy may have masked some differences between the groups. An example of such a possibility can be seen in paper II, table 3 (page 18). Here, the mean estimated Framingham risk by BMI show a significant difference among men in Oslo but no significant difference was seen among Sinhalese men. Interestingly the differences between the highest and lowest estimated Framingham risk was the same for both groups.

Systematic errors, known as bias, are broadly categorized in to 3 groups; selection bias, information bias and confounding [82, 85, 86]. We shall now discuss possible errors pertaining to this study.

4.1.1 Selection bias

The HUBRO study invited all Oslo residents born in 1924, 1925, 1940, 1941, 1955, 1960 and 1970, and a total of 18770 individuals (46%) participated. Some of the factors that affected attendance negatively were; low or lower secondary education, being young, being a male and not being born in Norway [87]. We cannot exclude the possibility of selection bias influencing on our results. However, an extensive analysis of non-attendance in HUBRO concluded that the prevalence estimates were robust in spite of considerable non-attendance [87].

In the Oslo Immigrant Health Study a total of 3019 (39.7%) participated. The highest rate of participation was among Sri Lankans at 50.9%. The rates of participation for different

groups were similar to what was found among immigrants in the HUBRO study [88]. Further analyses suggest that the conclusions from the published non-attendance study in HUBRO also apply to the Immigrant study (available at - http://www.fhi.no/dokumenter/C1E43891DD.pdf).

Those who attended the Oslo immigrant health study received the main questionnaire with the invitation to participate in the study. At the health screening, a supplementary questionnaire was also handed out. However, only 47% of the immigrants who completed the main questionnaire returned the supplementary questionnaire. The fat consumption comparisons (paper III) are partly based on data from the supplementary questionnaire. The possibility of selection bias cannot be excluded here as well. On the other hand a comparison of those who completed the supplementary questionnaire with those who did not showed only moderate differences between the two groups (available at- http://www.fhi.no/dokumenter/C1E43891DD.pdf).

In the Kandy studies government electoral lists were used as the sampling frame, and we may have left out persons not registered. On the other hand, as the register is updated frequently and being on the list is important for those aged 18 and above to have the universal franchise, we can presume that the majority is listed on it. Previous epidemiological studies in Sri Lanka have also used the list as the sampling frame [45, 63, 89].

In the Kandy Tamils study a simple random sample of the total Tamil population over the age of 18 years living within the study area was selected which minimizes sampling bias and maximizes representation. As discussed in paper I and II using surnames to identify Tamils from the electoral list may have left out some Tamils who may have surnames that are not easily identifiable as Tamil. Selection bias in the Kandy Tamils study may not be fully dismissed although the rate of participation was high at 74% for men and 92% for women. Since no data was collected on non-responders in Kandy we do not know if they were similar or not to the responders.

In the Sinhalese study a two stage random sampling method with proportional numbers of participants from each of the GN divisions was used. This could have introduced cluster effects. As reported in paper II (page 13) additional analyses did not indicate cluster effects. In the Sinhalese study participation was low among men (52%), which was a

concern but no data on non-participants was collected. On the other hand lipid levels were compatible with a previous study from Kandy among middle aged men [63].

4.1.2 Information bias

The two studies in Kandy were designed to be as similar as possible to the Oslo study but there were some differences which needs attention.

The anthropometric measures in Kandy followed the methodology adopted in Oslo except the instruments used for weight and height. We used the same steel measuring tape in all studies for measuring waist circumference.

In Kandy a Salter medical scale, which was calibrated daily against known weights, was used compared to an electronic weight measuring instrument in Oslo but the subjects were measured under similar conditions as mentioned in the methodology section (page 22). In Kandy height was measured with a Statometer, which was not calibrated, while in Oslo an electronic instrument was used. The data collectors in Oslo and Kandy were not the same. The differences in instruments and observers may have introduced errors across and within the sites. Overall Oslo had considerably higher heights, BMIs and abdominal obesity which are unlikely due to measurement errors alone.

The blood pressure data should be interpreted with caution as blood pressure measurement techniques differed between the studies. The Oslo study used the automatic Dinamap method which is known to measure a lower diastolic, but not systolic blood pressure, than manual mercury sphygmomanometer [90]. In Kandy there was a chance of introducing inter-observer errors since there was more than one observer. Except for that, measurements were conducted under similar conditions at both sites, non-fasting and resting. However, the large differences in systolic blood pressure between Kandy Tamils and others can probably not be accounted for by the measurement methods alone, especially since in our study Sinhalese men had the lowest systolic blood pressure (article II, page 19).

Laboratory tests of lipids were conducted in 3 different laboratories in our studies, and in one of the laboratories a drift was detected for total cholesterol and HDL cholesterol. Cross calibration (conf. methods section**,** page 26) was done based on reanalyzes of samples from

the Tamil study at the reference laboratory in Oslo and at the Kandy laboratory used in the Sinhalese study. However, ideally all of the samples should have been analyzed at the same laboratory.

Most of the questions in the Kandy study were directly imported from the Oslo study while some were adjusted to fit the local context as discussed below. There may have also been differences in reporting between Oslo and Kandy since Oslo had self administered questionnaires while the questionnaires were interviewer administered in Kandy. On the other hand, in the Oslo immigrant health study there were assistants speaking the language of the participants to help with the questionnaires.

In Oslo, age and country of birth information was collected from the registers while in Kandy age, sex and ethnicity was verified at the time of recruitment. Questions on socio-demographics and medical history were the same in all studies.

It is a limitation of our studies that comprehensive nutritional information not was collected. Data on types of food consumed and frequencies were collected using non validated questions, but they have been developed in Oslo using findings from previous studies from Norway, existing scientific knowledge and also needs and priorities of the researchers (available at- http://www.fhi.no/dokumenter/906123CAA9.pdf) . Even validated questionnaires on food frequencies and patterns have their own problems of validity and reliability [91].

Some of the questions on food habits; whether the type of fat used for cooking and applying was oil, hard or soft margarine or butter, frequency of consumption of; vegetables, fruits, liquor were similar across studies. In addition, in Kandy, we also inquired about the exact type of fat; coconut/palm or soya/sunflower oil, hard/soft margarines and butter/ghee and also the frequency of use to suit the local context and to be able to assess the exact type of oil/fat. Also the frequency of consumption of coconut fat/cream, coconut milk and flesh were recorded. Similar data were not available from the Oslo study. However, we employed data from the supplementary questionnaire in the Oslo immigrant health study on frequency of use of oil for cooking, fat for spreading and coconut fat/cream use, to compare with Kandy indirectly. Paper III (page 3 & 4) deals with the above aspects in detail.

Fish consumption data was only available for Oslo and Kandy Sinhalese which is a drawback. In addition, the questions in Kandy and Oslo were not similar. In Oslo the question was on frequency of consumption of fatty fish but in Kandy it was on consumption of fish in general. In Kandy "fatty fish" usually does not mean much as we in Sri Lanka do not differentiate fish as fatty and non-fatty but rather as white and red fish (personal experience of the candidate). In the Kandy Tamils study we had missed collecting data on fish consumption altogether which was a drawback. Due to these issues, we decided that it was not meaningful to present data on fish consumption.

Detection and therefore, reported prevalence of chronic illnesses, like hypertension may depend on several factors, for example age of a given population or availability and accessibility of health services. If the health services are not accessible cases may go undetected. Developing countries generally tend to have less extensive health care services. However, Sri Lanka has an extensive and an efficient health care service. Total fertility rate of 2.4, 99.4% of pregnant women receiving care from a qualified health worker (consultant obstetrician, medical doctor or trained midwife), 99% of deliveries attended to by a health professional, infant mortality rate of 15 per 1000 live births and a life expectancy of 71 for men and 76 for women support the above claim [92]. Sri Lankan health service is free for all and arguably one of the best in the developing world. Treatment for hypertensions as well as many other illnesses are provided free of charge at state run hospitals. In this study self reported hypertension in Kandy was higher compared to Oslo (paper I). Utilization of health services in foreign countries by immigrants may be affected by the extent to which they are integrated in to the host society. However, Sri Lankans in Norway are known to be well integrated in to the Norwegian society [93], and more Sri Lankans in Oslo reported hypertension and diabetes compared to Norwegians [78].

Although similar questions were used in all surveys, smoking and alcohol habits may have been under reported, especially in the interviews in Kandy. Smoking and alcohol are not socially acceptable habits any more in the country. Some of the participants may have down reported especially as the investigators included doctors. Compared to previous studies from Sri Lanka, the prevalence of smoking was lower among Tamils but more or less similar among Sinhalese [63]. Patel found smoking to be lower among migrant Gujarat's in UK but in contrast Sri Lankans in Oslo seem to smoke more than the Kandy

Tamils but less than Kandy Sinhalese [76, 78]. It may be that the Kandy Tamils down reported smoking.

The questions on spare time physical activity used in all three surveys have not been validated among immigrants. However, it has been validated among European populations [94]. Physical activity during spare time may only be of importance to those engaged in sedentary professions/occupations. Those involved in labor intensive occupations may actually be physically active during work hours. In our study we could not assess physical activity during work hours which was a shortcoming.

Migration is an age old process of humans and even animals. Migrants may be a selective group from the country of origin and may also be healthier than the general population of the host country. Convergence hypothesis suggests that migrants will totally integrate in to the host society including health status. (Confer introduction, page 8, for more details). Migration during the first two decades of life to prosperous countries have been shown to give rise to more adverse outcomes compared to later in life migration [95, 96]. Effect of age at migration and duration are also important aspects that needs to be considered but has not been taken in to account by many studies as well as ours [96].

Apart from that environmental differences during various stages of development in places of study may affect the risk factors differently [96]. The time gap between Tamils and Sinhalese studies in Kandy may have introduced such differences but we believe that the time gap was too short for drastic changes to occur. Besides no apparent huge socio-economic changes took place in Kandy during that period. The long standing conflict in the country which came to an end in 2009 also did not have any visible effects on the economy and social life of Kandy.

Predicted risk CVD/CHD

The Framingham CHD risk estimation equation used in this study was developed for a white, middle aged, high risk population, and the question is how well it performs in non whites and also whites from other age groups and geographical areas [8, 37, 97-99]. When applying a CVD/CHD risk estimation model developed for a defined population to another population, the accuracy of estimates will depend on 3 major characteristics. They are “(1) the nature and strength of the association between each risk factor included in the model and the risk of a cardiovascular event; (2) mean levels (or prevalence) of the risk factors;

and (3) background incidence of cardiovascular disease" [100]. Therefore recalibration according to local CHD rates and risk factor levels has been suggested. Two studies have been conducted in order to evaluate how well the Framingham model works in other ethnic groups, one in minority groups in the US [99] and one in China [8]. In both studies prospective data on CHD were collected and they were compared with original participants in the Framingham study. In both studies it was concluded that the Framingham model performed well after recalibration. We are not aware of studies assessing the prospective relation between risk factors and CVD among Sri Lankans or in other groups from the Indian Sub-continent. However, in India a model recalibrated by national risk factor and mortality data performed well where the original model overestimated the risk [101]. Cappuccio et al [99] applying Framingham risk estimates to ethnic minorities in UK shows the need to recalibrate the risk estimates. Since our aim was to compare the estimated CHD and CVD risk between Sri Lankans in Oslo and Kandy, re-calibration was not absolutely necessary. However, accurate estimates would be of importance in a clinical setting.

4.2 Discussion of main findings

Generalizability

The sample of Tamils and Sinhalese in Kandy may be representative of the population living in the Kandy municipal council to whom the results could be generalized. As will be shown below the results are more or less comparable with other studies on the general population of different areas of Sri Lanka including Kandy, suggesting that the results might be applicable to the general population of Sri Lankans.

Migrants are generally a selected group of people who are usually more resourceful and may be socio-economically stronger compared to their non-migrant brethren [102]. As discussed in paper I (page 6) the present group of migrants too appear to have had better childhood economic stability as shown by higher stature and more years of education received [95]. The Sri Lankans, most of them of Tamil ethnicity, in Oslo therefore may not be representative of all Sri Lankan Tamils. On the other hand, one could speculate if these results might be applicable to the large number of Sri Lankan Tamil migrants who have settled down in countries of Europe, UK, USA, Canada, Australia and New Zealand.

The Sri Lankans in Oslo in our study had better lipid profiles but had higher rates of obesity. The overall estimated risk of CHD and CVD was lower in Oslo compared to Kandy. To compare with our findings, we only found a few studies describing risk between migrant and non migrant south Asians which we will refer to later [76, 103-105].

Lipids

The expected difference in total cholesterol was for Sri Lankans in Oslo to have higher levels than their counterparts in Kandy since it is a known relationship with increasing BMI [3, 106]. However, it was not significantly different in men and in women it was lower in Oslo compared to Kandy (Paper II). In contrast Naeem et al found that Norwegian Pakistanis participating in the Oslo Health Study had high total cholesterol than Pakistanis in Pakistan [105]. Gujarati migrants to UK also had higher cholesterol compared to fellow Gujarat's in Gujarat [76] and so were Indians in west London compared to their siblings in India [103].

Low HDL is a characteristic of south Asian populations living in western countries [50, 51] and Sri Lankans in Oslo were also shown to have lower HDL compared to Norwegians [78]. The Sinhalese and Tamils of Kandy had lower HDL compared to Oslo Sri Lankans. HDL in Kandy was similar to a previous study in Kandy [63]. A nationally representative study reported a higher concentration of HDL among adults in Sri Lanka compared to the Kandy groups and Oslo Sri Lankans [107]. The Gujarat migrant study found higher HDL among immigrants to UK compared to their counterparts in Gujarat, but they also had higher total cholesterol [76]. On the other hand, Australian Indian women compared to their siblings in India were shown to have lower HDL [108].

The total to HDL cholesterol ratio was significantly higher in Oslo compared to Kandy (papers I and II). The lipid difference was the basis for the lower predicted CHD/CVD risk in Oslo. Improved lipid profiles among the migrant group might be the result of better nutritional practices adopted as a result of taking residence in Norway, a country which has seen a positive change of dietary habits (paper III). In our study triglycerides was not different between Oslo and Kandy, whereas it was higher among the immigrants in the Gujarat study [76]. Triglycerides in known to be higher among south Asians living in

western countries and it was higher among Sri Lankans compared to Norwegians in Oslo [50, 51, 78].

There were small differences in the lipids between the groups in Kandy. However, Kandy Tamil women tended to have lower HDL and higher total to HDL cholesterol ratio, which is part of the explanation together with their higher blood pressure for having higher predicted CHD risk than Sinhalese women.

Food habits

Changes in food habits mainly the types of fat consumed, may be have given rise to the changes observed in Oslo as discussed in paper III. Ethnic Norwegian men were shown to have lower triglyceride levels and higher HDL compared to immigrants from Sri Lanka in Oslo despite a higher BMI [78]. It has also been observed that despite increasing body weight the CVD burden has decreased in Norway, and blood lipids and the quality of the diet has improved over the last 30 to 40 years [109]. The average Norwegian diet might be more in line with a prudent dietary pattern which is protective against CVD [110]. The Sri Lankans in Oslo, despite higher BMI, had better lipid profiles compared to Kandy. As has been discussed in paper III, the Oslo group most probably was consuming healthier fats compared to Kandy. In Oslo consumption of polyunsaturated fats appears to be much higher. The changes in dietary fat consumption and composition and lower consumption of vegetables and fruits may be interpreted as adaptation to a more Norwegian type of a diet and/or substitution of type of fats used in the diet [109]. A diet rich in polyunsaturated fats and lower in saturated fat can be protective against CVD by improving the lipid profiles [22]. At least partial adoption of the Norwegian diet may have helped the immigrants. Dietary fat consumed in Kandy appears to be mostly of the saturated type from coconut products which may be the reason for the poorer lipid profile [111, 112]. The patterns of fat consumption observed fits fat availability in different regions of the world (Paper III) [1].

Higher frequency of consumption of vegetables and fruits may act as a protective factor in Kandy (Paper III).

BMI/central obesity

More obesity was observed in Oslo compared to Kandy (paper I and II). Higher obesity indices following migration has been reported previously: in the Gujarat study lower BMI and lower prevalence of overweight and central obesity was found among the non-migrant group [76] and Norwegian Pakistanis in Norway had higher BMI compared to Pakistanis in Pakistan [105] and Indians living in west London compared to their siblings in India [103]. Higher prevalence of overweight among migrants may be the result of increased caloric intake following migration to wealthier nations or decreased energy expenditure. The latter is not in concert with lower levels of physical activity reported in Kandy compared to Oslo. Increase of BMI has been shown to coincide with increasing wealth [3]. BMI of Oslo group was nearer the ethnic Norwegian BMI values than the Kandy values [78]. The prevalence of overweight among the migrants in our study was similar to the value found among migrant south Asians to the UK [51] and to the prevalence for Norwegians [1].

A greater proportion of women were overweight compared to men in both Kandy and Oslo, which is in line with other studies among Sri Lankans in Sri Lanka [64, 113, 114]. Compared to other studies in Sri Lanka, men in Kandy had similar prevalence of overweight and similar BMI's whereas women had higher abdominal obesity but more or less similar mean BMI's and prevalence of overweight [63, 64, 89, 114]

Obesity itself is a risk factor for CVD [94, 115] and the Oslo group may be able to reduce risk further by reducing BMI. Even at BMI's below 25 Kgm^{-2} higher risk of having CVD risk factors; high blood pressure, high total cholesterol, low HDL, triglycerides and fasting glucose was found among Indians, Singaporeans Chinese and Malays [116]. A BMI of $\geq$21.5 Kgm^{-2} has been suggested as a determinant of high CVD risk for Sri Lankans [114].

Blood pressure

Blood pressure was highest among Kandy Tamils (paper II page 9). The figures are higher than what has been reported earlier in Sri Lanka [63, 64]. Mean blood systolic blood pressure among Oslo and Sinhalese groups was close to the values reported previously from Sri Lanka [45, 63, 64] . Migration to the west has been shown to associate with high

blood pressure in previous studies [76, 77, 103]. The expected here would have been to see higher blood pressure among the migrants to Oslo. However prevalence of hypertension among Tamils was close to WHO estimates for Sri Lanka [1]. Higher blood pressure in Kandy Tamils can probably not be explained by lower detection since a higher proportion was on antihypertensive medication and health care is provided free of charge to the patients in Sri Lanka. It is interesting to note that systolic blood pressure of males in the lowest and medium educated categories were similar between Oslo and Kandy Tamils while higher educated people among Tamils had higher systolic blood pressure compared to their counterparts in Oslo (and compared to those with low education). As discussed previously the blood pressure results should be interpreted with caution due to the different methods used in Oslo and Kandy.

Smoking

Sinhalese men were smoking much more than the Tamils and Oslo men. Among men in the Oslo Health Study, Sri Lankans had the lowest smoking prevalence [78]. A study from Sri Lanka among the general population in 2005 found similar smoking rates as seen among Tamils here whereas two other studies from Colombo and Kandy Sri Lanka found rates similar to Sinhalese [45, 63, 64]. WHO estimates of prevalence of current daily smoking of 21.4% in Sri Lanka is slightly higher than observed for Tamils and Oslo group but lower than for Sinhalese [1]. In contrast the Gujarat migration study found the migrants to UK smoking more than those in Gujarat [76]. High prevalence of smoking among Sinhalese men put them at a higher predicted risk of CHD/CVD despite lower blood pressure (paper II page 12).

Almost all women in Oslo and Kandy were non-smokers in agreement with low smoking prevalence among south Asian [1].

Physical activity

The Oslo group reported higher levels of physical activity with a little less than half the group engaging in some kind of physical activity during leisure time (paper III page 7 & 8). Women in Kandy reported least physical activity. A review of studies on physical

activity in UK states that level of physical activity is lower among south Asians compared to Caucasians [117]. Sri Lankans in Oslo reported less physical activity than Norwegians [78]. A study from Australia finds those living in India are more physically active compared to their relative living in Australia [108].WHO estimated that the prevalence of insufficient physical activity in Norway was around 50% whereas it was only about 20% for Sri Lanka [1]. The estimates are based on data supplied by countries that have come from the general population samples. We cannot compare our data with those from WHO since we do not know the methodology involved in the relevant studies. Our methodology has been discussed in paper III (page 5 & 8) in more detail. We acknowledge that there were short coming in our methodology. Some of the correlates of physical activity are age, social barriers, availability of facilities, perceptions of overweight and health, seeing others exercise and culture [118, 119]. Data available does not permit further analysis of physical activity and its determinants and reasons for differences but a more conducive environment in Oslo may be the driver.

Estimated risk of CHD/CVD

The multinational INTERHEART case-control study reported a similar relation between risk factors and CHD in various populations around the world [9], and one of the participating centers in that study was located in Sri Lanka. However, it should be added that the prospective relations between CVD risk factors and later CVD have, to our knowledge, not been reported in South Asian population.

The risk of CVD is better assessed combining the various risk factors in a prediction model, like the Framingham risk model and the SCORE model, than by the traditional approach of considering each risk factor independently [120-122].

It has previously been reported that the SCORE risk assessed by the total to HDL cholesterol ratio model yielded rather similar risk for Sri Lankans in Oslo compared to Norwegians [78]. Whereas the Norwegians had better lipid profile, they smoked more and tended to have higher blood pressure compared to the Sri Lankans in Oslo [78].

As previously discussed, the higher predicted risk of CHD/CVD in Sri Lanka compared to Oslo could be attributed to a better lipid profile in Oslo. Both the Framingham and SCORE

risk models estimated higher risk in Kandy compared to Oslo. The Framingham model estimated the risk of an incident CHD whereas SCORE model estimated the risk of a fatal CVD event. The Framingham model included diabetes whereas SCORE model did not (paper II page 7 & 8).

We found that the Framingham risk decreased with more education in Oslo women. This finding is consistent with previous reported lower risk among higher socio economic groups in developed countries [123, 124]. The lowest educated among the Sinhalese women had the lowest estimated risk. Tamil men with more years of education were worse off with regard to triglycerides, obesity indices and systolic blood pressure. These findings are consistent with certain risk factors being lower among lower socio economic groups and vice versa in developing countries [1, 60, 125]. However there appears to be changes occurring in these patterns in the developing world as well where smoking, physical inactivity, total and LDL cholesterol and triglycerides decreased with increasing education and smoking and diabetes was more prevalent in the more educated [125].

5.0 Conclusions

Despite a lower BMI, Tamils and Sinhalese in Sri Lanka had higher estimated cardiovascular risk compared to Sri Lankans in Norway, mainly due to poorer lipid profiles. It might be that type of fats consumed in Oslo act as a protective factor for Oslo Sri Lankans compared to a predominantly saturated fat diet which appears to be low in polyunsaturated fatty acids in Kandy. Sri Lankans in Oslo reported higher levels of spare time physical activity which is another life style protective factor against CVD. Higher reported consumption frequency of fruits and vegetables in Kandy might be protective for those in Kandy. The overall low smoking rate among native and migrant Sri Lankans is a clear health benefit.

5.1 Implications for further research

A thorough examination of food and dietary habits of Sri Lankans in Oslo and those in Kandy is warranted. Main differences in predicted risk of CVD were most probably due to differences in dietary pattern between the two groups. We may elicit better results if we could compare a group of Sri Lankans who are closely related to those living in Oslo instead of studying cross sections of the general population since migrants are generally a selected group of people. Ultimately, studies not only predicting risk, but actually assessing the prospective relation between risk factors and future CVD is warranted.

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Comparison of cardiovascular risk factors between sri lankans living in kandy and oslo

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Abstract

Background: South Asians living in western countries are known to have unfavourable cardiovascular risk profiles. Studies indicate migrants are worse off when compared to those living in country of origin. The purpose of this study was to compare selected cardiovascular risk factors between migrant Sri Lankans living in Oslo, Norway and Urban dwellers from Kandy, Sri Lanka.

Methods: Data on non fasting serum lipids, blood pressure, anthropometrics and socio demographics of Sri Lankan Tamils from two almost similar population based cross sectional studies in Oslo, Norway between 2000 and 2002 (1145 participants) and Kandy, Sri Lanka in 2005 (233 participants) were compared. Combined data were analyzed using linear regression analyses.

Results: Men and women in Oslo had higher HDL cholesterol. Men and women from Kandy had higher Total/HDL cholesterol ratios. Mean waist circumference and body mass index was higher in Oslo. Smoking among men was low (19.2% Oslo, 13.1% Kandy, P = 0.16). None of the women smoked. Mean systolic and diastolic blood pressure was significantly higher in Kandy than in Oslo.

Conclusions: Our comparison showed unexpected differences in risk factors between Sri Lankan migrants living in Oslo and those living in Kandy Sri Lanka. Sri Lankans in Oslo had favorable lipid profiles and blood pressure levels despite being more obese.

Background

Cardiovascular disease (CVD) risk profile of South Asians living in western countries is characterized by low High Density Lipoprotein (HDL) cholesterol, central obesity and increased diabetes mellitus together with higher rates of myocardial infarctions, re-infarctions and higher mortality rates from Coronary Heart Disease (CHD) [1-4]. By grouping South Asians together, some studies may have overlooked inherent differences amongst them [2].

At present South Asia is experiencing a rapid increase in CVD particularly in the urban areas and among higher socioeconomic classes [5-10]. Studies comparing migrant Indians in UK and USA with those living in India observe migrants having higher mean total cholesterol, triglycerides and Body Mass Index (BMI) but no consistent difference in HDL [11,12].

In Sri Lanka coronary heart disease (CHD) is a main cause of morbidity and mortality [13,14]. Sri Lankan studies suggest concentration of risk factors in urban areas and higher socioeconomic classes with an increasing prevalence among younger people [8-10,15]. A diet rich in carbohydrates and saturated fats (coconut is the major supplier of fat energy) but low in protein may contribute to the worsening burden of CVD and diabetes [9,16]. It has been previously reported from Oslo, Norway that Sri Lankan migrants have lower HDL cholesterol and higher triglycerides compared to Vietnamese, Iranians and ethnic Norwegians[17]. The prevalence of central obesity was highest among Sri Lankan and Pakistani women in Oslo and both men and women had higher Waist to Hip ratios for any given BMI compared to other immigrant groups [18]. To our knowledge, no studies comparing Sri Lankan migrants and a native group in Sri Lanka have been published. Our study compares cardiovascular risk factors from a population based study in Kandy Sri Lanka

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with data from Sri Lankans participating in the Oslo Immigrant Health Study. The study design and implementation in Kandy was as similar as possible to the Oslo study to facilitate the comparison.

Methods

Study population - Oslo, Norway

The population based, cross sectional Oslo health study (HUBRO) and Oslo immigrant health study were conducted between 2000 and 2002 by the Norwegian Institute of Public Health and the University of Oslo [17]. Both studies used the same protocol. In HUBRO, all Oslo residents born in 1924, 1925, 1940, 1941, 1955, 1960 and 1970 were invited. In the Oslo immigrant health study, all those born between 1942 and 1971in Sri Lanka, Turkey, Iran Vietnam and a 30% random sample of Pakistanis living in Oslo were invited, except for those who previously had been invited to HUBRO [19]. An invitation and the main questionnaire were sent to participants 2 weeks before the screening followed by a reminder to non responders. In both studies the questionnaires were also available in the appropriate languages of the five immigrant groups. Here we have included participants from both studies born in Sri Lanka between 1940 and 1971, and in this group the response rate was 50% in HUBRO (143 participants) and 50.9% in the Oslo immigrant health study (1002 participants) [19]. The majority of the Sri Lankans (99%) in Oslo belonged to the Tamil ethnic group.

Study population - Kandy, Sri Lanka

The population based cross sectional study in Kandy was conducted in the municipal council area between August and December 2005 among ethnic Tamils. The target was 300 men and women between the ages of 30 and 60 years. The government electoral list for 2004 in which those above 18 years are required to register was the sampling frame [8-10,20]. Tamils were identified by their family names and selected through simple random sampling. All the selected persons were then invited at house visits after verification of ethnicity and age. Of those invited, 74 percent of the men and 92 percent of the women participated.

Data collection

Data collection in Kandy followed the Oslo study with a very similar protocol. In Oslo, participants completed a questionnaire, with or without assistance, while participants in Kandy were interviewed using a structured questionnaire. In both studies years of education, personal history of chronic diseases and medication and smoking habits were recorded. The Norwegian population register provided information on age and gender and country of birth which was taken as the county of origin [19]. In Kandy date of birth was recorded at the interview while gender was provided by the electoral list. Body weight and height were measured with electronic Height and Weight Scale in Oslo and a Salter medical scale and a Statometer in Kandy, with the participants wearing light clothing without shoes. BMI (kg/m^2) was calculated accordingly [19]. Waist circumference, at the midpoint between the iliac crest and lower margin of ribs was measured with the subject standing and breathing normally to the nearest 0.1 cm with the same steel measuring tape utilised in both studies.

Systolic and diastolic blood pressures were measured three times at one-minute intervals in mmHg by an automatic device (DINAMAP, Criticon, Tampa, USA) in Oslo and with a mercury sphygmomanometer in Kandy. The mean of the last two recordings were used in this paper. Hypertension was defined as systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg or being on blood pressure lowering drugs.

Non-fasting blood samples were collected and serum total cholesterol, serum HDL cholesterol and serum triglycerides were measured directly by an enzymatic method. This was done at the Department of Clinical Chemistry, Ullevål University Hospital, Oslo, Norway which was the reference laboratory, (Hitachi 917 auto analyzer, Roche Diagnostic, Switzerland) and ESPEE laboratory Kandy Sri Lanka (COBAS MIRA 36-3122 auto analyzer).

Cross calibration of serum analysis

For purposes of comparison, serum from a random sample of 14 persons from the Kandy study was re-analyzed at the reference laboratory in Oslo.

As the Kandy results for total cholesterol and HDL cholesterol showed systematic differences from the Oslo results a further 182 samples were re-analyzed at the reference laboratory, including 8 of the initial 14. Adjustments in total cholesterol and HDL cholesterol values from the Kandy study were thus made according to the reference laboratory scale. Triglyceride values did not differ between the two laboratories.

Ethical considerations

The Higher Degrees and Research Ethics committee of the University of Peradeniya, Sri Lanka approved the Kandy study. HUBRO and the Oslo Immigrant Health Study were approved by the Norwegian Data Inspectorate and cleared by the Regional Committee for Medical Research Ethics.

Data analysis

Combined data were analyzed by SPSS version 16 using linear regression and UNIANOVA methods with all variables adjusted for age, except age. Triglycerides were also adjusted for time since last meal. Regression analyses assumptions (linearity and similar variance over

different levels of the dependent variable) were checked by inspecting plots of residual against predicted values.

Results

A total of 685 men and 460 women from Oslo and 103 men and 130 women from Kandy were included in the analysis whose general characteristics are described in Table 1.

Compared to Oslo, mean age was higher and mean years of education lower in Kandy (Table 1).

Men in Oslo had higher mean HDL cholesterol compared to men in Kandy. Their mean total to HDL cholesterol ratio was lower whereas total cholesterol and triglycerides were similar to Kandy. Prevalence of unfavourable HDL was higher among Kandy men while prevalences of high total cholesterol, total to HDL cholesterol ratio and triglycerides were similar (Table 2). Oslo women too had higher mean HDL cholesterol and lower total cholesterol, total to HDL cholesterol ratios and triglycerides. Prevalence of unfavourable blood lipids was higher in Kandy women.

Table 1 Characteristics of the study populations in Oslo, Norway and Kandy, Sri Lanka (Age adjusted means and prevalences*)

	Oslo	Kandy	P**
MEN			
N	685	103	
Age (years)	40.0	46.4	< 0.01
Education (years)	13	10	< 0.01
Total cholesterol (mmol/l)	5.4	5.2	0.18
HDL cholesterol (mmol/l)	1.07	0.89	< 0.01
Total/HDL cholesterol ratio	5.3	6.3	< 0.01
Triglyceride (mmol/l)***	2.6	2.6	0.95
Height (cm)	168	163	< 0.01
Body Mass Index (kg/m^2)	25.7	22.5	< 0.01
Waist circumference (cm)	89	81	< 0.01
Systolic blood pressure (mmHg)	126	129	< 0.02
Diastolic blood pressure (mmHg)	77	83	< 0.01
Current smoking (%)	19	13	0.16
WOMEN			
N	460	130	
Age (years)	39	45.6	< 0.01
Education (years)	12	10	< 0.01
Total cholesterol (mmol/l)	5.0	5. 3	< 0.01
HDL cholesterol (mmol/l)	1.21	0.98	< 0.01
Total/HDL cholesterol ratio	4.3	5.7	< 0.01
Triglyceride (mmol/l)***	1.8	2.2	< 0.01
Height (cm)	155	150	< 0.01
Body Mass Index (kg/m^2)	26.8	24.7	< 0.01
Waist circumference (cm)	84	80	< 0.01
Systolic blood pressure (mmHg)	119	129	< 0.01
Diastolic blood pressure (mmHg)	69	82	< 0.01
Current smoking (%)	0	0	

*The model is evaluated at mean age of 40.7, P** = significance test for equality, ***triglycerides also adjusted for time since last meal.

Men and women in Oslo were about 5 cm taller than their counterparts in Kandy. Mean Body Mass Index was higher in Oslo by about 2 and 3 units respectively among women and men. The Oslo sample also had larger mean waist circumferences.

No women smoked and in men 19% in Oslo and 13% in Kandy reported current smoking (p = 0.16).

Mean systolic and diastolic blood pressure and prevalence of hypertension was higher in Kandy. Current use of antihypertensive medications was reported by 9% of men and 11% of women in Oslo and 12% of men and 17% of women in Kandy.

Triglycerides increased by years of education among men in Kandy. No other statistically significant relations between education and blood lipids in men were found (Table 3). Among Kandy women, mean HDL increased with years of education while in Oslo a decrease in mean total to HDL cholesterol ratio and an increase in mean HDL were suggested.

BMI and waist circumference increased with years of education among Kandy men but not women. In Oslo there was no clear association between education and waist circumference or BMI, except that the men with the least education had higher waist circumferences. Height increased with education in all groups except for men in Oslo.

Systolic blood pressure showed a significant increase with education in both men and women from Kandy. Men from Kandy and Oslo with the least education had similar levels of blood pressure while the gap widened at the other end. Women too had a somewhat similar pattern. Among Oslo women, those with the highest education had lowest systolic blood pressure.

Smoking was not clearly associated with education although those with the highest level of education in Kandy had the lowest prevalence of 1.3% (P (equality) = 0.07, data not shown).

Discussion

The Kandy sample had less favourable lipid profiles compared to Oslo with lower HDL cholesterol and higher total to HDL cholesterol ratios. Kandy women also had higher triglycerides. Parameters of elevated blood pressure were significantly higher in Kandy. On the other hand the Oslo sample was heavier and had larger waist circumferences. In Kandy those with more years of education appeared to be worse off with regard to blood pressure, than those with lower years of education. Among Kandy men obesity and triglycerides were positively related to education. Smoking was low among men and no women reported smoking.

Table 2 Prevalence (%) of selected risk factors among men and women from Oslo and Kandy (Age adjusted)

	Oslo Prevalence	Kandy Prevalence	P*
Men			
N	685	103	
High Total cholesterol ≥ 6.2 mmol/l	19.2	20.0	0.89
Low HDL ≤ 0.9 mmol/l	27.8	58.3	< 0.01
High Total to HDL cholesterol ratio ≥ 4.4	70.1	77.9	0.39
High Triglyceride ≥ 2.7 mmol/l**	33.1	39.7	0.24
General obesity ≥ 25 kg/m^2	58.3	19.6	< 0.01
High Waist circumference ≥ 90 cm	43.7	16.2	< 0.01
Hypertension- SBP ≥ 140 mmHg, DBP ≥ 90 mmHg or on antihypertensive	17.3	33.3	< 0.01
Women			
N	460	130	
High Total cholesterol ≥ 6.2 mmol/l	8.9	25.9	< 0.01
Low HDL ≤ 1.0 mmol/l	24.7	53.3	< 0.01
High Total to HDL cholesterol ratio ≥ 4.4	43.0	69.0	< 0.01
High Triglyceride ≥ 2.2 mmol/l**	25.7	35.8	< 0.01
General obesity ≥ 25 kg/m^2	68.2	48.2	< 0.01
High Waist circumference ≥ 80 cm	66.0	46.2	< 0.01
Hypertension- SBP ≥ 140 mmHg, DBP ≥ 90 mmHg or on antihypertensive	9.3	38.2	< 0.01

The model is evaluated at mean age of 40.7, P* = significance test for equality.
**triglycerides adjusted for time since last meal.
SBP = systolic blood pressure. DBP = diastolic blood pressure.

In our study the Oslo migrants had a better blood lipid profile than their counterparts in Kandy. Given the higher obesity indices, unfavourable lipid profiles would have been expected among the migrants [21]. A possible increase in protein intake and changes in the type of fat could attribute for the favourable lipids among the migrants [22,23]. Ethnic Norwegian men showed lower triglyceride levels and tended to have higher HDL compared to immigrants from Sri Lanka in Oslo despite a higher BMI [17]. It has also been observed that despite increasing body weight the CVD burden has decreased in Norway, while blood lipids and the quality of the diet has improved over the last 30 to 40 years [24]. Sri Lankan migrants to Oslo might be consuming a diet relatively rich in fatty fish and unsaturated fats contributing to the improved lipid profiles. Compared to a previous study among males in Kandy the present study observes similar mean HDL cholesterol and total cholesterol in Kandy [8].

Few studies compare South Asian migrants from Western Countries with those in the country of origin. A study comparing Gujarat migrants in the UK with Gujarat's in India from a similar geographic, cultural and genetic background found higher serum total cholesterol, triglycerides, general and central obesity and blood pressure among the migrants [11]. On the other hand, migrants had higher HDL and smoked less.

In the Gujarat study, shorter stature, lower BMI and lower prevalence of overweight and central obesity was found among the non-migrant group, similar to our study [11]. Higher prevalence of overweight among migrants may be the result of increased caloric intake among them following migration. The prevalence of overweight among the migrants in our study was similar to the value found among migrant south Asians to the UK [25]. A greater proportion of women were overweight compared to men in both Kandy and Oslo which is consistent with other studies among Sri Lankans in Sri Lanka [26]. Compared to other studies in Sri Lanka, men in Kandy had a similar prevalence of obesity whereas women had higher abdominal obesity but similar mean BMI's [10,20,27]. A recent study among the general population of Sri Lanka reports lower mean BMI and lower prevalence of overweight and obesity than found in our study for both men and women but the same study reports higher obesity indices for urban areas [26]. An increase in height by education has been observed among immigrants in UK as shown in our study in Kandy [25]. Stature is an indicator of childhood availability of nutrition and may be an indicator of parental socio-economic status [25,28].

The migrants in our study had lower blood pressures in contrast to the Gujarati Study where the migrants had higher blood pressure [11]. Higher blood pressure

Table 3 Selected risk factor associations with years of education in Kandy and in Oslo (age adjusted)

		Men				Women			
Education (years)		**0-8**	**9-12**	**> 13**	**p***	**0-8**	**9-12**	**> 13**	**p***
Participants (Number)	Oslo	29	330	295		35	225	126	
	Kandy	22	62	19		35	71	24	
HDL cholesterol (mmol/l)	Oslo	1.01	1.08	1.07	0.81	1.20	1.19	1.25	0.06
	Kandy	0.91	0.91	0.90	0.75	0.96	0.96	1.05	0.05
Total cholesterol to HDL ratio	Oslo	5.8	5.3	5.3	0.52	4.5	4.3	4.2	0.09
	Kandy	6.3	6.3	6.9	0.57	6.1	6.0	5.3	0.32
Triglycerides** (mmol/l)	Oslo	2.9	2.6	2.5	0.84	1.9	1.7	1.7	0.78
	Kandy	1.8	2.7	3.0	< 0.03	2.1	2.2	2.3	0.74
Waist circumference (cm)	Oslo	92.6	88.5	88.7	0.13	83.6	84.5	82.8	0.13
	Kandy	75.4	81.9	88.2	< 0.01	78.4	82.5	81.3	0.72
BMI (kg/m^2)	Oslo	26.7	25.7	25.8	0.85	27.3	27.2	26.5	0.16
	Kandy	20.9	23.1	23.7	< 0.01	23.7	26.3	24.7	0.80
Height (cm)	Oslo	167.6	167.3	168.2	0.22	154.9	155.2	156.2	< 0.01
	Kandy	160.3	162.5	164.5	< 0.01	147.0	150.0	150.5	< 0.03
Systolic blood pressure (mmHg)	Oslo	124.4	126.5	126.5	0.95	119.1	119.4	115.8	< 0.01
	Kandy	123.2	128.5	133.0	< 0.01	123.6	131.1	132.6	< 0.04

The model is evaluated at mean age of 40.7, p* = significance test for trend, **triglycerides also adjusted for time since last meal.

in Kandy can probably not be explained by lower detection since a higher proportion was on antihypertensive medication and health care is provided free of charge to the patient in Sri Lanka. Kandy participants in our study had higher mean systolic blood pressure compared to other studies in Sri Lanka [8-10]. It is interesting to note that systolic blood pressure of males in the lowest and middle education categories were similar between Oslo and Kandy while higher educated people in Kandy had much higher systolic blood pressure compared to their counterparts in Oslo. This finding is compatible with the finding of higher CVD risk among upper socio-economic groups in developing countries [7].

Compared to the Gujarat study where more natives were current smokers no significant difference was observed between Oslo and Kandy. In Oslo, smoking prevalence among Sri Lankan men was lower than ethnic Norwegians which corresponds to studies from UK where South Asian migrants were not smoking as much as the ethnic British [2,4,17]. A study from southern Sri Lanka in 2005 found similar smoking rates as seen here in Kandy but a much higher prevalence was found in Kandy in 1995 [10,29]. A recent study by Katulanda et al reported much higher prevalence of smoking among men in the general population of Sri Lanka than found in our study [15]. All women were non-smokers consistent with low smoking prevalence among south Asian women in UK, India and Sri Lanka [2,11,29].

In Kandy, men with more years of education were worse off with regard to triglycerides, obesity indices and systolic blood pressure. Similar observations have been made in other developing countries where higher socio-economic standards were associated with unfavourable CVD risk factors [7,30].

Strengths and weaknesses

By design the two studies are similar. Data collection in Kandy was carried out 3-5 years after Oslo. In Kandy no program to change CVD risk factors in the community

took place and no major economical or social conditions change occurred during this time period. Therefore these factors may not have implications on the results of the study.

An important objective of our study is the comparison of two groups with similar ethnic and cultural backgrounds. On the other hand the Tamils in Oslo are not necessarily representative of all Sri Lankan Tamils. Migrants are in general a selected group of people who are healthier and also in most cases socio-economically better off. This is demonstrated in our study by the higher level of education and higher stature among the immigrants which could indicate better socio-economic standards during childhood giving them an advantage socially and economically by being the fittest in the community [25].

The significant difference in mean age of the two groups may not have contributed to the significant differences since an analysis of lipids and blood pressure of the groups divided at median age revealed no consistent pattern of the older group having higher rates of the risk factors.

Despite biochemical measurements being done at two different laboratories, a cross calibration was done to enable a valid comparison.

The blood pressure data should be interpreted with caution as blood pressure measurement techniques differed between the studies although similar conditions; non-fasting and resting prevailed in both places, The Oslo study used the automatic Dinamap method which is known to measure a lower diastolic blood pressure [31]. However, the large differences in systolic blood pressure between Kandy and Oslo can probably not be accounted for by the measurement methods alone, especially since the systolic blood pressure among the lower educated in Kandy and Oslo was similar.

The lower rate of participation among Oslo group is an issue of concern as one of the factors affecting attendance in Oslo was level of education http://www.fhi.no/artikler/?id=53584. Therefore we cannot exclude selection bias. However, no significant gradients between education and risk factors in Oslo were observed, except for height and systolic blood pressure in women. An analysis of the effects of non-participation in HUBRO and the Oslo Immigrant Health Study concluded that prevalence estimates might be valid despite considerable nonattendance [32].

The electoral list, used for random sample generation in Sri Lanka in earlier studies, provided the sample frame [8,9]. Simple random sampling maximized the representation of the population studied. Participation was high at 92.2% for women and 74.1% for men which limits the selection bias. On the other hand a larger sample would have increased the power to detect smaller differences in risk factors, and the small sample size in Kandy may have masked some differences between the two groups. No data on non-participants was collected which is a shortcoming. Using surnames to identify Tamils in Kandy has limitations.

Conclusions

Compared to Kandy, we found migrant Sri Lankans in Oslo to have higher rates of general and central obesity, which might be due to life-style changes following migration [11]. Higher HDL and lower total to HDL cholesterol ratios in the Oslo group could also be attributed to life style changes. Lower HDL and higher total cholesterol to HDL ratios among Kandy men and women and also higher total cholesterol among women put them at a higher risk for cardiovascular disease in spite of lower BMI and lower waist circumferences. Higher triglycerides in Kandy, despite of lower BMI, in contrast to other studies comparing migrants and those in country of origin, is noteworthy since a triglycerides are known to be positively associated with BMI [11]. Men in Kandy with more education seem to be at a higher risk than those with lower education by way of higher triglycerides, obesity and blood pressure, consistent with other studies [7,26,30]. Our study shows that management of obesity among Sri Lankan migrants needs immediate attention in Oslo while there is a great need for management of unfavourable serum lipids in Kandy.

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Authors' contributions

SUBT participated in the design of and collection of data in the Kandy study and the statistical analysis and drafting of the manuscript. HEM conceived of the study and participated in the design and coordination of the studies in Oslo and Kandy and in statistical analysis and drafting of the manuscript. BNK participated in the design and coordination of the study and drafting of the manuscript. DBN participated in the coordination of the Kandy study and drafting of the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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II

III

Differences in selected life style risk factors for cardiovascular disease between Sri Lankans in Oslo, Norway and in Kandy, Sri Lanka

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Abstract

Background: We have previously reported that migrant Sri Lankans living in Oslo had lower predicted risk of cardiovascular disease (CVD) compared to Sri Lankans in Kandy mainly due to a better lipid profile. In this article we present some dietary and other life style risk factor differences between Sri Lankans in Oslo, Norway and Kandy, Sri Lanka which may influence the risk of CVD.

Methods: Using data from three cross-sectional studies we compared indicators of life style risk factors related to cardiovascular diseases: type of fat consumed, fruit and vegetable intake, alcohol consumption and leisure time physical activity between 1145 Sri Lankans living in Oslo and 678 Tamils and Sinhalese Sri Lankans living in Kandy.

Results: Sri Lankans in Oslo were consuming healthier fats compared to Kandy. They also reported higher levels of physical activity during spare time. Vegetable and fruit consumption in Oslo was lower. Tamil men reported the lowest alcohol consumption frequency. Alcohol consumption among women was negligible in all groups.

Conclusions: Type of fats consumed in Oslo might be a protective factor for Oslo Sri Lankans compared to a predominantly saturated fat diet which appears to be low in polyunsaturated fatty acids (PUFA) in Kandy. Higher physical activity levels may also be protective for Oslo Sri Lankans. Consuming vegetables and fruits at a higher frequency may confer protection to those living in Kandy.

Key words: cardiovascular risk, ethnic groups, immigrants, south Asians, life style risk, fat consumption, fruits and vegetable consumption

Introduction

At present Cardiovascular diseases (CVD) are the number one cause of death globally, and the burden is increasing in low and middle income countries [1]. South Asians appear to be at a higher risk of CVD according to expatriate and native South Asian studies [2-9]. In Sri Lanka, coronary heart disease (CHD) is a main cause of morbidity and mortality [10, 11]. Unhealthy diet, physical inactivity and tobacco smoking are important behavioral risk factors for CVD [1]. Nutritional factors can influence on blood lipids, blood pressure, blood glucose and overweight and obesity which are also known as intermediate risk factors for CVD [1]. A diet rich in carbohydrates and saturated fats but low in polyunsaturated fats is implicated in the worsening epidemic of CVD and Diabetes among south Asians including in Sri Lanka [9, 12-15]. We have earlier reported data on blood lipids, blood pressure and smoking comparing urban Sri Lankans from Kandy, Sri Lanka and Sri Lankans in Oslo, Norway. In spite of higher BMI and more obesity, the Sri Lankans in Oslo had better lipid profiles and lower predicted CVD risk than their counterparts in Sri Lanka [16, 17].

On this background the aim of the present study was to compare selected life style risk factors with special focus on indicators of dietary fat consumption between Sri Lankans in Oslo, Norway and Sinhalese and Tamils of Kandy, Sri Lanka.

Methodology

The present analysis is based on the three studies performed in urban Sri Lankan Tamils, urban Sri Lankan Sinhalese and Sri Lankans living in Oslo, Norway. They have been described in detail earlier [16, 17], and a brief description is given here.

Study population - Oslo, Norway

We included data from participants born in Sri Lanka between 1940 and 1971 participating in the population based, cross sectional Oslo health study (HUBRO) and the Oslo immigrant health study conducted between 2000 and 2002 by the Norwegian Institute of Public Health and the University of Oslo [18, 19]. The response rate was 50% in HUBRO (143 participants) and 50.9% in the Oslo immigrant health study (1002 participants) [18]. Out of those responding to the main questionnaire in the Oslo immigrant health study, 40% of the Sri Lankans responded to the supplementary questionnaire (available at http://www.fhi.no/artikler/?id=53584).

Study population –Tamil ethnic group Kandy, Sri Lanka

The population based cross sectional study among urban Tamils of Kandy Sri Lanka was conducted in the Kandy municipal council area between August and December 2005 [16]. The government electoral list for 2004 was the sampling frame which also has been used in other studies [8, 20, 21]. A simple random sample of Tamils, identified by family names, were selected and invited at house visits. Ethnicity and age was verified at the time of recruiting. The participation rate was 74% (N=103) among men and 92% (N=130) among women.

Study population – Sinhala ethnic group Kandy, Sri Lanka

The population based cross sectional study among the urban Sinhalese of Kandy municipality area was carried out between September 2008 and April 2009. A two stage random sampling method was used. Urban Kandy comprises of 41 grass root level administrative divisions known as Grama niladari areas out of which 22 were randomly selected in stage one. In stage two, 8.5% of the population from each of the 22 areas was selected randomly but due to time constraints we ended up recruiting from only 11 of the GN. Age was verified at the time of recruitment. Government electoral list was the sampling frame [8, 16, 20]. Rate of participation was 52% (n=147) and 87% (n=302) among men and women respectively.

Data collection

Kandy studies followed the Oslo study with a similar protocol as far as possible. In Oslo, participants completed a questionnaire, with or without assistance, while participants in Kandy were interviewed using a structured questionnaire. In all studies, years of education, personal history of chronic diseases including diabetes mellitus and medication and smoking habits were recorded using similar questions. The Norwegian population register provided information on age and gender and country of birth which was taken as the county of origin. In Kandy date of birth was recorded at the interview while gender was provided by the electoral list.

Most of the questions in the Kandy study were directly imported from the Oslo study, which had already been completed before the Kandy studies, while some were adjusted to fit the local context. Both in Kandy and Oslo they were asked what kind of fat they used most often for cooking and for spreading, with the alternatives being dairy butter (butter/ghee was added as an alternative in Kandy), hard margarine, soft/light margarine, oil or none. There were three questions concerning the consumption of full fat milk, semi skimmed milk and skimmed

milk with categories ranging from seldom/never to 4 glasses or more per day in Oslo. Fresh milk is not commonly used in Sri Lanka, Instead, the consumption of full fat and non-fat milk powder was assessed with two questions in Kandy: one on frequency per day and the other on average number of teaspoons each time. In all studies, they were also asked about how often they usually ate cooked vegetables, raw vegetables/salads and fruit/berries.

In Kandy we also asked if the type of oil used was coconut/palm or soya/ sunflower oil. In Kandy frequency of use of fats for cooking and spreading as well as the frequency of use of coconut fat, cream, milk and flesh were also asked for. We did not have the same questions in the Oslo studies. We therefore had to rely on questions inquiring on how often they used oil for cooking and how often they used coconut fat/milk for cooking from the supplementary questionnaire in the Oslo immigrant health study (available at http://www.fhi.no/artikler/?id=53584). From this questionnaire we also got information on how many slices of bread they were consuming and how often they used butter, margarine or oil as a spread on bread.

Data pertaining to the main questionnaire, which were comparable between Oslo and Kandy, are thus presented in Table 1. Data from Kandy on type of oil/fat use and frequency are presented in Table 2a and data from the supplementary questionnaire in Oslo in Table 2b. The tables also present the stem of the questions asked and relevant alternatives.

Leisure time physical activity was assessed in a four graded question in all studies (level 1: reading, watching television, or other sedentary activity; level 2: walking, bicycling, or moving around in other ways at least 4 h a week; level 3: participating in recreational athletics, heavy garden work, etc., at least 4 h a week; level 4: participating in hard training or athletic competitions, regularly and several times a week).

Frequency of use of alcohol was assessed through a question on how often they consumed alcohol during the last year with the alternatives ranging from never to daily consumption.

Ethical considerations

The Higher Degrees and Research Ethics committee of the University of Peradeniya, Sri Lanka approved both studies in Kandy. HUBRO and the Oslo Immigrant Health Study were approved by the Norwegian Data Inspectorate and cleared by the Regional Committee for Medical Research Ethics.

Data analysis

Combined data were analyzed using frequency measures and chi square testing and ordinal regression for categorical data and ANOVA for continuous variables. Unadjusted results are presented. Adjusting for age and education did not change the results substantially.

Results

Men and women in Oslo were younger and had had more years of education than their counterparts in Kandy. Oslo Sri Lankan, Kandy Tamil and Kandy Sinhalese men had a mean age of 40, 46 and 47 ($P<0.01$) years respectively, and had 13, 11 and 12 ($P<0.01$) years of education. The corresponding figures in women were 39, 46 and 46 ($P<0.01$) years of age and 12, 10 and 11 ($P<0.01$) years of education.

Almost all men and women in Kandy were using oil for cooking purposes (Table 1), and about 95% of both Tamils and Sinhalese were using oil daily (Table 2). Out of those using oil the great majority reported use of either coconut or palm oil (97% in Sinhalese men, 93% in Sinhalese women, 89% in Tamil men and 83% in Tamil women- data not shown).

In Kandy a substantial proportion did not use fat for spreading, and the use of soft/light margarine ranged from 18% in Tamil women to 28% in Sinhalese women. However, in those who used soft/light margarine, the proportion who used it daily was low (5% and 21% among men, 13% and 9% among women, Tamils and Sinhalese respectively, data not shown).

In Oslo around 90% were using oil for cooking (Table 1), but only about a third of men and women reported use 5-7 times a week (Table 2b). The great majority reported infrequent/seldom use of coconut cream/fat in cooking and the highest frequency of use (5-7 times a week) was reported by 1% of men and women only.

In Oslo around 50% were using soft/light margarines for spreading (table 1). Nearly 50% reported that they used fat daily for spreading, and on average the men consumed 4.5 and the women consumed 4.0 slices of bread daily which contributes to the quantity of consumption of fat (data not shown).

The proportion drinking milk daily in Oslo was 23% for full cream milk, 27% for semi-skimmed milk and 5% for skimmed milk. Few were drinking more than one glass per day. One glass of full cream milk contains around 6 grams of fat. In Kandy, on average, 3.7 (approximately 2.25 g of fat per teaspoon) teaspoons of milk powder was consumed daily

while close to 80% were consuming more than 4 teaspoons. Almost all were consuming full cream milk powder.
Consumption of cooked vegetables in Kandy was high with almost all consuming once or more times a day, whereas in Oslo only around one third reported that they consumed cooked vegetables daily. Raw vegetable and fruit consumption too was higher in Kandy than in Oslo (Table 3).
Over 85% of both Tamils and Sinhalese were consuming white rice 1 to 3 times a day (data not shown). Comparable data was not available in Oslo.
Among men, alcohol intake appeared to be lowest among Tamils in Kandy, but there were no dramatic differences in reported frequency among the groups (Table 3). We also performed tests to compare Tamils with Sinhalese and Tamils with Oslo Sri Lankans separately. Alcohol consumption by Tamils was lower compared to the other two groups. Among women, alcohol consumption was negligible (data not shown).

The Oslo group reported higher levels of physical activity with a little less than half the group engaging in some kind of physical activity during leisure time (Table 4). Women in Kandy were the least physically active.

Discussion

In Kandy almost all were using oil for cooking out of which close to 90% was using coconut or palm oil. In addition, coconut cream was also used daily by the great majority. Less than a quarter used soft light margarines for spreading. Among those who used soft/light margarines, daily consumption was low.
In Oslo about 90% were using oil for cooking but daily use was reported by about a third only. Coconut fat usage was very low. Half the group in Oslo used soft/light margarines for spreading. Consumption of fruits and vegetables was higher in Kandy. The Oslo group reported more physical activity compared to the Kandy groups.

Strengths and weaknesses

A conscious effort was made to make all three studies as similar as possible. The questionnaire in Kandy was prepared based on the Oslo immigrant health study questionnaire with some changes to fit the food patterns in Kandy. Similar questions assessed the type of fat used for cooking and spreading. However, some of the data could not be compared directly

due to methodological differences which have been explained in the methodology section. Kandy questionnaire was adjusted to include sections that we thought were important in the context which enabled questions on coconut fat/cream usage although we didn't have similar questions to compare with in Oslo. It is a weakness that there were no questions that adequately assessed the frequency of use of fats in Oslo in the main questionnaire. Therefore we had to rely on the supplementary questionnaire in Oslo despite its lower response rate. The supplementary questionnaire was returned by less than half of those who responded to the main questionnaire, which may affect validity further. On the other hand, a non-respondent analysis of the supplementary questionnaire found that those who attended and not-attended had similar characteristics **(**available at-
http://www.fhi.no/dokumenter/C1E43891DD.pdf).

The studies did not include a comprehensive dietary assessment like an extensive food frequency questionnaire, and we have information on frequency of use and not portion size. In Oslo, the intake of fatty fish was asked for. However, a similar question was not available in the Kandy studies as fatty fish is not a term found in general use. We are therefore left with some dietary indicators, and the questions do not provide a complete picture of, for example, fat intake.

Food pattern/frequency questionnaires have their own problems of validity and reliability [22]. The fact that the food pattern/frequency questionnaire used was not validated was a concern too. Since we were comparing dietary patterns with similar questionnaires in two locations among people of the same ethnic group, the comparison may be acceptable, but there was a chance that the same question may have been interpreted differently in the two environments. However, the pattern of fat consumption observed fits the available knowledge about fat availability in different regions of the world [23].

Physical activity in general is difficult to assess. Researchers over time have tried various methods to evaluate physical activity. A review article on physical activity questionnaires conclude that most of the questionnaires reviewed were poorly constructed which showed that assessing physical activity is a tedious task [24]. The questions used in our study have been validated for European populations but not for non-European immigrants in Europe or for those living in south Asian countries [25]. The questions may be more apt for a developed country environment but we believe that it could be applied to Sri Lanka as well for leisure time physical activity. A major drawback is that we haven't assessed physical activity during work hours. Physical activity warrants further investigation.

Rate of participation in the Oslo study was about 50% and only about a half of that responded to the supplementary questionnaire which is a weakness. Analysis of non participants of the HUBRO study suggest that the prevalence estimates may be valid [26].

Discussion of the findings

Our study suggests that in Sri Lanka coconut/palm oil, coconut cream and coconut flesh is extensively used for cooking purposes. About 90% of the fats in coconut is saturated, and coconut cream and flesh are also rich sources of fat since cream and flesh contains about 34% fat and milk about 24% fat [27-29]. Use of soft/light margarines in Kandy was very limited and so was the use of other oils containing high amounts of polyunsaturated fatty acids. This suggests that the ratio of saturated to polyunsaturated fats in the diet of Kandy groups could be very high. Previous publications show that although total fat intake is not high in Sri Lanka, 70% to 80% of total fat energy is derived from saturated fatty acids and the saturated to polyunsaturated fat ratio is around 9/1 compared to the current recommended ratio of <1/1 [12, 28, 30].This ratio appears to be much higher than the WHO estimate of only about 50% fat energy being supplied by saturated fat in the south-east Asia region [23]. A diet low in polyunsaturated fats but high in saturated fats can give rise to unfavorable lipid profiles [30-32]. A recent FAO/WHO report conclude that replacing saturated fat with polyunsaturated fat leads to a decrease in low density lipoprotein (LDL) cholesterol and the total to high density lipoprotein (HDL) cholesterol ratio [31]. They also conclude that substituting dietary sources of saturated fat with carbohydrates decrease both LDL and HDL cholesterol.

Our previous finding of lower HDL cholesterol and higher total to HDL cholesterol ratio in Kandy compared to Oslo [16, 17], could fit with a higher saturated to polyunsaturated fat ratio in Kandy combined with a high intake of refined carbohydrates, as suggested by our own data where the majority are consuming polished rice in Kandy (data not shown). In Sri Lanka carbohydrates contribute about 65% of the daily energy intake [12]. Unfortunately we do not have data on macronutrient distribution in our studies. In addition, the fiber content of white rice is much lower than that of brown rice (2.1g compared to 16.7g per 100g rice [33]). Low fiber content in diet can increase the risk of having an unfavorable lipid profile further [34]. The role of fat in prevention of CHD has recently been debated but, the several systematic reviews conclude that there is convincing evidence that replacing saturated fats with polyunsaturated fats decreases the risk of CHD [31, 35]

A study in Sri Lanka where dietary Saturated Fatty Acids (SFA) from coconut fat was partially replaced by PUFA was shown to increase HDL cholesterol concentration and decrease total cholesterol and LDL cholesterol. The authors of this study conclude that maintaining the PUFA: SFA ratio around 1 will give rise to a favorable HDL level. [28]. A natural experiment reported from the Polynesian atolls found that higher intake of saturated fat from coconut was associated with a high total cholesterol level [32].

Our data suggests that among Sri Lankans in Oslo use of coconut fat is very low and that a larger proportion of people do use soft/light margarines on a regular basis compared to Kandy as shown by high frequency of use of fat for spreading. A previous publication from the Oslo immigrant health study reported that changes of dietary habits following migration to Oslo among Sri Lankans includes increased consumption of margarine [36]. In Oslo oil was used at a lower frequency than in Kandy and in general oils used in Oslo are rich sources of polyunsaturated fats. Unfortunately we do not have information on type of oil used in Oslo. WHO also reports that in northern European countries only about a third of the total fat energy is supplied by saturated fats [23].
Fatty fish consumption which is an important source of good quality oils could not be compared since the question on fish in Kandy was not specific to fatty fish unlike in Oslo.

The reported vegetable and fruit consumption was lower in Oslo than in Kandy as has been shown among Mexican migrants to USA following acculturation [37]. In isolation, the higher vegetable and fruit intake reported may be a protective factor for those living in Kandy [38]. Since the FFQ has not been validated for Sri Lankans the information may not be accurate.

A review of studies on physical activity in UK states that level of physical activity is lower among south Asians compared to Caucasians [39]. Our study suggests that the group in Oslo was more physically active than the groups in Kandy during leisure time. Some of the correlates of physical activity are age, social barriers, availability of facilities, perceptions of overweight and health, seeing others exercise and culture [40, 41]. Data available does not permit further analysis of physical activity and its determinants and reasons for differences but a more conducive environment in Oslo may have helped.

Conclusion

Type of fat used and frequency of consumption in Oslo might be a protective factor for Oslo Sri Lankans. They may have integrated in to the Norwegian society by way of which they may also be consuming a more nutritious and a balanced diet. In Kandy the dietary fat consumed appears to be predominantly of the saturated type. Consumption of PUFA appears to be very low. Spare time physical activity was reported to be higher in Oslo among both men and women which is another life style protective factor against CVD. The apparently lower intake of fruits and vegetables in Oslo may act as a risk factor.

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Tables

Table 1.Type and frequency of fat use for cooking and spreading and frequency of consumption of vegetables and fruits

		Men				Women			
	Category	Oslo (%)	Tamil (%)	Sinhala (%)	P*	Oslo (%)	Tamil (%)	Sinhala (%)	P*
N		685	103	143		460	130	302	
					<0.01				
Type of fat used for cooking	Dairy butter/ghee	3	0	0		2	1	0	<0.01
	Hard margarines	3	0	0		3	0	0	
	Soft/light margarines	3	1	1		5	0	1	
	Oil	90	98	98		90	99	98	
	None	1	1	1		0	0.	1	
Type of fat used for spreading	Dairy butter/ghee	25	10	3	<0.01	17	13	8	<0.01
	Hard margarines	7	22	9		10	15	7	
	Soft/light margarines	46	19	22		54	18	28	
	Oil	2	7	32		3	19	39	
	None	19	42	34		16	35	23	
Cooked vegetables	Seldom/never	2	0	1	<0.01	1	0	0	<0.01
	1-3 times a month	7	0	1		6	0	0	
	1-3 times a week	24	0	2		20	1	0	
	4-6 times a week	35	0	0		35	0	1	
	1-2 times a day	25	56	38		28	67	42	
	>3 times a day	9	44	60		11	32	57	
Raw vegetables	Seldom/never	10	23	8	<0.01	10	14	4	<0.01
	1-3 times a month	23	9	7		19	7	6	
	1-3 times a week	37	40	51		38	50	50	
	4-6 times a week	18	3	17		17	4	19	
	1-2 times a day	9	25	17		11	24	20	
	>3 times a day	3	0	0		5	2	1	
Fruits/berries	Seldom/never	4	4	6	<0.01	3	3	4	<0.01
	1-3 times a month	9	7	4		8	9	3	
	1-3 times a week	30	43	38		32	34	31	
	4-6 times a week	26	9	12		24	6	15	
	1-2 times a day	25	36	40		28	43	46	
	>3 times a day	6	2	1		7	5	1	

P* significance test for equality

- Sources of data: responses to questions in the Oslo Health Study and Oslo Immigrant Health Study main questionnaires and the Kandy studies.

Table 2

Table 2A. Frequency of use of oil (soya/sunflower/palm/coconut) and other coconut products in Kandy

		Men			Women		
	Category	Tamil (%)	Sinhala (%)	P*	Tamil (%)	Sinhala (%)	P*
N		*103*	*143*		*130*	*302*	
Oil	Seldom/never 1-3 times a month 1-3 times a week 4-6 times a week	4	8	0.60	2	6	0.06
	1-2 times a day	60	53		67	53	
	>3 times a day	36	39		30	41	
Coconut milk [a]	Seldom/never 1-3 times a month 1-3 times a week 4-6 times a week	4	3	<0.01 [b]	5	0	<0.01 [b]
	1-2 times a day	60	22		56	19	
	>3 times a day	36	75		40	81	
Coconut flesh [a]	Seldom/never	9	19	<0.01	4	12	<0.01
	1-3 times a month	5	0		3	0	
	1-3 times a week	35	14		29	10	
	4-6 times a week	19	8		19	10	
	1-2 times a day	29	55		42	60	
	>3 times a day	3	5		3	6	

P* significance test for equality

[b] statistical test unreliable since more than 25% of the cells have expected count less than 5

- Source of data: questions specific to the Kandy studies

2b Frequency of consumption of oil, coconut cream, fat for spreading and number of slices of bread in Oslo

	Category	Men (%)	Women (%)
N		*240*	*215*
Oil use for cooking	Seldom/never	5	6
	1-3 times a month	9	9
	1-2 times a week	19	16
	3-4 times a week	35	31
	5-7 times a day	32	38
Coconut fat /milk use	Seldom/never	50	53
	1-3 times a month	30	27
	1-2 times a week	12	12
	3-4 times a week	7	7
	5-7 times a week	1	1
Frequency of use of fat on bread	Daily	45	43
	Now and then	41	38
	Seldom/never	14	19

- Source of data: supplementary questionnaire of the Oslo Immigrant Health Study.

Table 3 Frequency of alcohol consumption in men

Category	Oslo (%)	Tamil (%)	Sinhala (%)	P*
N	*656*	*103*	*128*	
4-7 times a week 2-3 times a week	18	18	17	< 0.01 <0.01[1] <0.001[2]
Once a week 2-3 times a month	32	15	21	
Once a month Few times last year	28	30	46	
Have not drunk past year Never drunk alcohol	22	37	15	

P* significance test for equality

[1] between Tamils and Sinhalese

[2] between Oslo and Tamils

- Sources of data: Main questionnaire of the Oslo studies and Kandy studies.

Table 4. Physical activity during leisure time

	Men				Women			
Category	Oslo (%)	Tamil (%)	Sinhala (%)	P*	Oslo (%)	Tamil (%)	Sinhala (%)	P*
N	*685*	*103*	*143*		*460*	*130*	*302*	
Read/watch TV/sedentary life	51	65	66	0.00	55	85	87	< 0.01
Walk/cycly/move≥4 times a week	36	21	29		38	9	12	
Physical exercise/ sports/ gardening≥4 times a week	8	14	5		4	5	1	
Hard exercise/ competitive sports regular	5	0	0		2	1	0	

P* significance test for equality

Sources of data: Main questionnaires of the Oslo studies and the Kandy studies.

Appendix I

Questionnaire of the Oslo Health study

THE OSLO HEALTH STUDY

Do not write here:

5.3 (Bydel)	(Fylke)	(Land)	9.3 (Aktivitet)		9.4 (Yrke)		14.7 (Merke)		
☐☐☐☐	☐☐	☐☐☐☐	☐☐☐	☐☐☐	☐☐☐	☐☐☐	☐☐	☐☐	☐☐☐☐

1. YOUR OWN HEALTH

1.1 How would you describe your present state of health? (*Mark only one answer with a cross)*

Poor	Not very good	Good	Very good
☐ 1	☐ 2	☐ 3	☐ 4

1.2 Do you have any of these illnesses, or have you suffered from of them in the past?

	Yes	No	Age on last occasion
Asthma	☐	☐	☐☐ yrs
Hay fever	☐	☐	☐☐ yrs
Chronic bronchitis/emphysema	☐	☐	☐☐ yrs
Diabetes	☐	☐	☐☐ yrs
Osteoporosis	☐	☐	☐☐ yrs
Fibromyalgia / chronic pain syndrome	☐	☐	☐☐ yrs
Mental disorders for which you sought help	☐	☐	☐☐ yrs
Cardial infarction	☐	☐	☐☐ yrs
Angina pectoris (cardiac spasm)	☐	☐	☐☐ yrs
Stroke/cerebral haemorrhage (“drip”)	☐	☐	☐☐ yrs

1.3 Have you ever noticed any sudden change of your pulse or heart beat during the past year? ☐ Yes ☐ No

1.4 Do you feel pain or discomfort when you: Walk up hills, climb stairs or walk fast on level ground? ☐ Yes ☐ No

1.5 If you do feel such pain, do you usually:

Stop?	Slow down?	Continue at the same pace?
☐ 1	☐ 2	☐ 3

1.6 If you stop, does the pain then disappear after less than 10 minutes? ☐ Yes ☐ No

1.7 Is such pain just as likely to occur when you are standing still or sitting / lying down? ☐ Yes ☐ No

2. MUSCULOSKELETAL DISORDERS

2.1 Have you suffered from pain and/or stiffness in muscles and joints in the course of the last 4 weeks?
(Duration to be stated only if you have been troubled in this way)

	Not troubled	Somewhat troubled	Very troubled	Duration: Up to 2 weeks	Duration: 2 weeks or more
Neck/shoulders.....	☐	☐	☐	☐	☐
Arms, hands.....	☐	☐	☐	☐	☐
Upper back.....	☐	☐	☐	☐	☐
Lower back.....	☐	☐	☐	☐	☐
Hips, legs, feet.....	☐	☐	☐	☐	☐
Elsewhere.....	☐	☐	☐	☐	☐

2.2 Have you ever:	Yes	No	Age on last occasion
Broken (fractured) your wrist/lower arm?.....	☐	☐	☐☐ yrs
Fractured your hip (neck of your femur)?.....	☐	☐	☐☐ yrs

3. OTHER DISORDERS

3.1 Below is a list of various problems. Have you suffered from any of the following during the last week (including today)?

(*Put a cross for every problem*)	Not troubled	Slightly troubled	Quite a lot troubled	Much troubled
Suddenly feel panicky for no reason.....	☐	☐	☐	☐
Suddenly feel frightened or anxious.....	☐	☐	☐	☐
Feel faint or dizzy.....	☐	☐	☐	☐
Feel tense or harassed.....	☐	☐	☐	☐
Easily find fault with yourself.....	☐	☐	☐	☐
Sleeplessness.....	☐	☐	☐	☐
Feel depressed, dejected.....	☐	☐	☐	☐
Feel useless, of little worth.....	☐	☐	☐	☐
Feel that everything is a burden.....	☐	☐	☐	☐
Feeling of hopelessness for the future.....	☐	☐	☐	☐
	1	2	3	4

4. USE OF THE HEALTH SERVICES

4.1 How many times during the last 12 months have you personally used:
(One cross on each line)

	None	1-3 times	4 times or more
General practitioner	☐	☐	☐
Company doctor.....	☐	☐	☐
Psychologist or psychiatrist..... *(private or at an outpatient clinic)*	☐	☐	☐
Other consultant (specialist) (*private or at an outpatient clinic*.....	☐	☐	☐
Emergency service ("doctor-on-call") (*private or public)*.....	☐	☐	☐
Admission to hospital	☐	☐	☐
Home nursing service.....	☐	☐	☐
Physiotherapist.....	☐	☐	☐
Chiropractor	☐	☐	☐
Dentist.....	☐	☐	☐
Alternative therapist.....	☐	☐	☐

5. WHERE YOU GREW UP / WHERE YOU BELONG

5.1 How long have you lived in Oslo altogether?..... ☐☐ yrs
(Write 0 if less than 6 months)

5.2 How long have you lived altogether in the district / sub-municipality of Oslo where you are living now? ☐☐ yrs
(Write 0 if less than 6 months)

5.3 Where did you live for most of the time before you reached the age of 16 years?

(Cross off one alternative and specify)

Same sub-municipality/district of Oslo ..... ☐1

Another sub-municipality/ district of Oslo ..... ☐2 _____

Another county in Norway ..... ☐3 Which _____

Outside Norway..... ☐4 Country _____

5.4 Have you moved in the course of the last five years?

No	Yes, once	Yes, several times
☐1	☐2	☐3

6. WEIGHT

6.1 Assess your weight when you were 25 years old: ☐☐☐ whole kg

7. FOOD AND DRINK

7.1 How often do you usually eat the following kinds of foods?
(Mark the appropriate answer with a cross on each line)

	Seldom/ Never	1-3 times. pr. mth	1-3 times. pr. week	4-6 times. pr. week	1-2 times. pr. day	3 times or more pr. day
Fruit/berries	☐	☐	☐	☐	☐	☐
Cheese *(all kinds)*	☐	☐	☐	☐	☐	☐
Potatoes	☐	☐	☐	☐	☐	☐
Cooked vegetables	☐	☐	☐	☐	☐	☐
Raw vegetables/salad ...	☐	☐	☐	☐	☐	☐
Fat fish(*e.g. salmon ..... trout, mackerel, herring)*	☐	☐	☐	☐	☐	☐
	1	2	3	4	5	6

7.2 What kind of fat do you use most often? *(One cross only on each line)*

	Dairy-butter	Hard margarine	Soft/light margarine	Oil	Do not use
On bread	☐	☐	☐	☐	☐
For cooking	☐	☐	☐	☐	☐
	1	2	3	4	5

7.3 Do you take the following food supplements?

	Yes, daily	Sometimes	No
Cod liver oil, cod liver oil capsules, fish oil capsules?	☐	☐	☐
Vitamin- and/or mineral supplement?	☐	☐	☐

7.4 How much do you usually drink of the following?
(One cross per line).

	Seldom/ Never	1-6 glass pr.wk	1 glass pr.day	2-3 glasses pr. day	4 glasses or more pr. day
Full cream melk, kefir, yoghurt	☐	☐	☐	☐	☐
Semi-skimmed milk, "cultura", light yoghurt	☐	☐	☐	☐	☐
Skimmed milk (sour/sweet)	☐	☐	☐	☐	☐
Fruit juice	☐	☐	☐	☐	☐
Water	☐	☐	☐	☐	☐
Carbonated bottled water	☐	☐	☐	☐	☐
CocaCola, Pepsi Cola or suchlike	☐	☐	☐	☐	☐
Other "fizzy"drinks/thirst quenchers	☐	☐	☐	☐	☐
	1	2	3	4	5

7.5 Do you usually drink thirst quenchers / Cola: With sugar ☐ 1 Without sugar ☐ 2

7.6 How many cups of coffee or tea do you drink <u>daily</u>?
(Write 0 if you do not drink coffee or tea daily)

Number cups coffee ☐☐ **Number cups tea:** ☐☐

7.7 What kind of coffee do you usually drink?

Filter-/ instant coffee..... ☐
"Boiled" (coarse ground)/ Cafeteria-made coffee ☐
Other coffee (espresso etc.) ..... ☐
Do not drink coffee..... ☐

7.8 How often have you consumed alcohol in the course of the <u>past year</u>?
(Low alcohol beer and non-alcoholic beer are not included)

4-7 times pr. wk ☐ 1 **2-3 times pr. wk** ☐ 2 **ca. once pr. wk** ☐ 3 **2-3 times pr. mth** ☐ 4 **About once pr. mth.** ☐ 5
A few times in the past year ☐ 6 **Have not drunk alcohol this past year** ☐ 7 **Have never drunk alcohol** ☐ 8

To those who have consumed alcohol during the past year:

7.9 When you consumed alcohol, how many glasses or drinks did you usually consume? *Number* ☐☐

7.10 How often in the course of the past year did you drink as many as at least 5 glasses or drinks in the course of one day? *Number of. times* ☐☐

7.11 When you drink, do you usually drink: *(Put more than one cross if applicable)*

Beer ☐ **Wine** ☐ **Spirits** ☐

8. SMOKING

8.1 How much time do you usually spend each day in a smoke-filled room?.....*Number whole hours.* ☐☐

Yes No

8.2 Did any of the adults in your home smoke when you were growing up?..... ☐☐

8.3 Are you living, or have you lived in the same house as **a daily smoker after reaching the age of 20 yrs?** **Yes No** ☐☐

	Yes, now	Yes, earlier	Never
8.4 Have you smoked/do you smoke daily?...	☐	☐	☐

If NEVER: Go straight to the questions on EDUCATION AND EMPLOYMENT)

8.5 If you smoke daily at present, do you smoke:	**Yes**	**No**
Cigarettes?	☐	☐
Cigars/cigarillos?	☐	☐
A pipe ?	☐	☐

8.6 If you have smoked daily before, how long is it since you stopped smoking? ..... *Number of years* ☐☐

8.7 If you smoke daily now, or have smoked before:

How many cigarettes do you or did you usually smoke daily? ..... *Number cigarettes* ☐☐

How old were you when you started to smoke daily? ..... *Age in yrs* ☐☐

How many years altogether have you smoked daily? .....*Number yrs .* ☐☐

9. EDUCATION AND EMPLOYMENT

9.1 How many years of schooling/education have you completed altogether?..... *Number yrs.* ☐☐

9.2 Are you currently employed?

Yes, full time ☐ 1 yes, part time ☐ 2 No ☐ 3

9.3 Describe the activity going on at the place of work (department) where you carried out paid work for the longest period of time during the last 12 months.*(E.g. Firm of Accountants, lower secondary school, pediatric department at a hospital, carpentry workshop, car repair workshop, bank, commodity trade, etc..)*

Activity:_____

If retired, state your activity and occupation before retirement.. Applies also to 9.4.

9.4 What is/was your occupation / title at this place of work?

(E.g. secretary, teacher, industrial worker, child nurse, cabinet maker, head of department, salesman, driver, etc..)

Occupation:_____

9.5 In your main occupation, are you self-employed, do you work as an employee or as a family member without an agreed fixed wage?

Self-employed	**Employee**	**Family member**
☐	☐	☐

9.6 Do you think you are in danger of losing your present work or income in the course of the next 2 years……..	**Yes**	**No**
	☐	☐

9.7 Are you receiving any of the following benefits?	**Yes**	**No**
Sick pay (Certified as being ill).....	☐	☐
Old-age pension, early retirement pension or widow(er)'s pension.....	☐	☐
Rehabilitation/training allowance.....	☐	☐
Disability pension (full or part).....	☐	☐
Daily allowance during unemployment.....	☐	☐
Social assistance / benefit.....	☐	☐
Interim allowance for single parents/supporters..	☐	☐

10. EXERCISE AND PHYSICAL ACTIVITY

10.1 What kind of physical activity have you undertaken in <u>you spare time</u> in the course of <u>the past year</u>?

Estimate a weekly average for the year.
From home to work is regarded as spare time. Answer both questions:

	Hours pr. week			
	None	Less than 1	1-2	3 or more
Light exercise				
(You do not sweat or feel out of breath)	☐	☐	☐	☐
Hard physical activity				
(You sweat and feel out of breath).....	☐	☐	☐	☐
	1	2	3	4

10.2 Describe the extent of movement and bodily exertion in <u>your spare time</u>. If the activity varies considerably, e.g. between summer and winter, then give an average. The question applies to <u>the past year</u> only.
(Mark the appropriate answer)

Read, watch TV or other sedentary activity? ..... ☐ 1

Walk, cycle or move about in some other way <u>at least 4 times per week</u>? ..... ☐ 2
(This should include walking or cycling to work, Sunday stroll/walk, etc.)

Take part in physical exercise/sport, do heavy gardening work? ☐ 3
(Note that the activity must take place at least 4 times a week)

Exercise hard or take part in competitive sport regularly and <u>several times a week</u> ..... ☐ 4

11. FAMILIY AND FRIENDS

11.1 Do you live together with another person? **Yes** ☐ **No** ☐

If <u>YES:</u>

	Yes	No	
Spouse/partner.....	☐	☐	
Other persons, 18 yrs or older	☐	☐	*Number* ☐☐
Persons under 18 yrs	☐	☐	*Number* ☐☐

11.2 How many good friends do you have? *Number of friends* ☐☐

Count those whom you can talk to in confidence and who can help you when you need help.
Do not count those who you live together with, but include other relatives.

11.3 How much interest do people show in the things you do?
(Only one cross)

Great interest	Some interest	Slight interest	No interest	Uncertain
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

11.4 How many societies, clubs, groups, congregations etc. do you take part in in your free time? *Number* ☐☐
(Put 0 if none)

11.5 Do you feel that you can influence what happens in the local community where you live?

Yes, to a large degree	Yes, to some degree	Yes, to a slight degree	No
☐ 1	☐ 2	☐ 3	☐ 4

12. SICKNESS IN THE FAMILY

12.1 Has either of your parents or any of your brothers/sisters had cardial infarction, or angina pectoris (cardiospasm)? .....

Yes	No	Do not know
☐	☐	☐

13. USE OF MEDICINES

Medicines, in this context, means medicines bought at a pharmacy. Food supplements and vitamins are not included here..

13.1 Do you take?

	Now	Earlier, but not now	Never used
Medicine for high blood pressure.....	☐	☐	☐
Cholesterol-reducing medicine.....	☐	☐	☐

13.2 How often in the course o f <u>the last 4 weeks</u> have you taken the following medicines?
(One cross per line)

	Daily	Every week but not daily	Less often than every week	Not taken during the last 4 weeks
Painkillers, off prescription.....	☐	☐	☐	☐
Painkillers, on prescription.....	☐	☐	☐	☐
Sedatives	☐	☐	☐	☐
Tranquillisers	☐	☐	☐	☐
Anti-depressives	☐	☐	☐	☐
Other medicine on prescription.....	☐	☐	☐	☐
	1	2	3	4

13.3 For those medicines you have crossed off in items 13.1 and 13.2, and you have taken <u>during the last 4 weeks:</u>

State the name of the medicines and your reason for taking/having taken them (disease, symptom):
(Cross off for how long you have taken the medicine)

Name of medicine: *(one name per line):*	**Reason for taking the medicine**	**How long have you taken the medicine? Up to 1 yr**	**One yr. or more**
_____		☐	☐
_____		☐	☐
_____		☐	☐
_____		☐	☐
_____		☐	☐
_____		☐	☐
_____		☐	☐

If there is not enough space here, continue on a separate page and enclose it with the form)

14. THE REST OF THE QUESTIONNAIRE IS TO BE ANSWERED BY WOMEN ONLY

14.1 How old were you when you had your first menstruation? ..... *Age in yrs.* ☐☐

14.2 If you no longer have menstruation, how old were you when you stopped? *Age in yrs* ☐☐

14.3 Are you pregnant at present?

Yes	No	Not sure	Past fertile age
☐ 1	☐ 2	☐ 3	☐ 4

14.4 How many children have you given birth to?.....*Number children* ☐☐

14.5 Do you use or have you used?
(One cross on each line)

	No	Before, but not now	Never
P-pill / minipill /p-injection	☐	☐	☐
Hormone loop	☐	☐	☐
Oestrogen *(tablets or plaster)*	☐	☐	☐
*Oe*strogen *(cream or suppositories)*	☐	☐	☐

14.6. If you take / have taken oestrogen that is on prescription:

How long have you taken this? ..... *Number yrs.* ☐

14.7 If you use the p-pill, mini-pill, p-injection, hormone loop or oestrogen; which preparation do you use?

_____

Appendix II

Questionnaire of the Kandy Tamils study

Questionnaire

Cardiovascular disease risk factors among urban Tamils of Kandy

- **Serial number** ☐
- **Date (dd/mm)** ☐
- **Interviewer** ☐

General information

1. Name ……

3. Sex ……

4. Date of birth ……

5. Place of birth ……

6. Religion ……

7. Years of education ……

8. Occupation

8.1 Are you currently employed?

Yes, full time ☐ Yes, part time ☐ No ☐

8.3 What is/was your occupation / title at this place of work?
(E.g. secretary, teacher, industrial worker, child nurse, head of department, salesmen, driver, etc)
…….

8.4 In your main occupation, are you self employed, do you work as an employee or as a family member without an agreed fixed wage?
Self- employed ☐ Employee ☐ Family member ☐

8.5 What is your monthly income? ……

8.6 What is the monthly income of your household? ……

9 How many members are there in your family

Total number ☐ Adults ☐

Children under 18years ☐

10. Health

10.1 How would you describe your present state of health?

1. Poor
2. Not very good
3. Good
4. Very good

10.2 Do you have any of these illnesses or have you suffered from them in the past? Are you on treatment? How long? What type of treatment? Regularly?

.	Age Of onset	Suffered		On treatment		How long	What type of treatment		Regular treatment	
		Yes	No	Yes	No	Years	Allopathic	Ayurveda	Yes	No
❑ Diabetes ❑										
❑ History of Hip/ wrist fracture										
❑ Cardiac infarction										
❑ Angina pectoris										
❑ Stroke/TIA										
❑ Hypertension										

10.3 Do you feel pain or discomfort in your chest when you: Walk up hills, climb stairs or walk fast on level ground? Yes ☐ No ☐

Do you get it when you walk at an ordinary pace on the level?

Yes ☐ No ☐

10.5 If you feel such pain, do you usually:

Stop? Yes ☐ No ☐

Slow down? Yes ☐ No ☐

Continue at the same pace? Yes ☐ No ☐

10.6 If you stop/slow down does the pain then disappear? Yes ☐ No ☐

10.7 If yes, after how long? 10 minutes or less ☐

More than 10 minutes ☐

10.8 Is such pain just as likely to occur when you are standing or sitting/lying down?

Yes ☐ No ☐

10.9 Have you ever had a severe pain across the front of your chest lasting for about half an hour or more? Yes ☐ No ☐

11. Body weight

11.1 Assess your weight when you were 25 years old. _____Kg

12. Smoking

12.2 Have you smoked/ do you smoke daily? Yes ☐ Yes earlier ☐ Never ☐

12.3 If you smoke daily at present, do you smoke?

- Cigarettes Yes ☐ No ☐
- Cigars Yes ☐ No ☐
- Beedee Yes ☐ No ☐
- Other Yes ☐ No ☐

12.4 If you have smoked daily before, how long is it since you stopped smoking?

Number of years……

If you smoke daily now, or have smoked daily before:

12.4 How many cigarettes do you or did you smoke daily? _____/day

12.5 How old were you when you started smoking daily? _____years

12.6 How many years altogether have you smoked daily? _____years

13. Food and drink

13.1

	Seldom/never	1-3 times per month	1-3 times per week	4-6 times per week	1-2 times per day	3 times or per day
White Rice /white rice flour products						
Red Rice /red rice flour products						
Wheat flour products - Bread/Roti						
Vegetable dishes that are cooked						
Raw vegetables/salad/greens						
Fruits/berries						
Pulses (cooked/boiled/wadai)						
Deep Fried snacks (rolls, patties)						
Home made sweets/desserts						
Toffees/chocolates						

13.2 What kind of fat do you use usually?

	Dairy butter	Ghee	Hard margarine	Soft light margarine	Coconut/palm oil	Soya/ sun flower oil	Non
On bread/ Roti/hoppers/thosai							
For cooking							

How often?

	Seldom/never	1-3 times a month	1-3 times per week	4-6 times per week	1-2 times per day	3 times or more per day
On bread/ Roti/ hoppers/thosai						
For cooking						

13.3 How often do you use coconut in food?

	Seldom/never	1-3 times a month	1-3 times per week	4-6 times per week	1-2 times per day	3 times or more per day
Coconut flesh						
Coconut milk						

13.4 Do you take food supplements?

Yes, daily ☐ Sometimes ☐ No ☐

If yes what supplements? _____

13.5 How often do you drink of the following?

	Seldom/never	1-6 glasses per week	1 glass per day	2-3 glasses per day	4 glasses or more per day
Water					
Coca cola and likes					
Other carbonated drinks					

13.6 If you drink Cola and other carbonated thirst quenchers, do you usually use once

with sugar ☐ without sugar ☐

13.7 How many cups of tea or coffee do you drink daily?

Number cups tea ……. Number cups coffee …….

13.7.1 Do you take sugar with tea or coffee? Yes ☐ No ☐

13.7.2 If yes how many times? ……../day

13.7.3 If so how many teaspoons of sugar do you use each time? ……Tsp

13.7.4 Do you take milk / milk powder with tea or coffee? Yes ☐ No ☐

13.7.5 If yes how many times a day? ……/day

13.7.6 If so how much each time?

Full cream milk powder…….Tsp

Non fat milk powder ……...Tsp

Milk ……cups

13.8 How often have you consumed alcohol in the course of the past year? (Low alcohol beer and non alcoholic beer are not included)

4-7 times/ week	2-3 times/ week	Once/ week	2-3 times/ month	Once/ month	Few times last year	Have not drunk this past year	Have never drunk alcohol

To those who have consumed alcohol during the past year

13.9.1 When you consumed alcohol, how many glasses or drinks did you usually consume?

Number_____ (☐asses ☐rinks)

13.9.2 How often in the course of the past year did you drink as many as at least 5 glasses or drinks in the course of one day?

Number of times_____

When you drink what do you usually drink?

Beer ☐ Wine ☐ Spirits ☐ Toddy ☐

14. Physical activity

14.1 On average how many hours a day do you spend at work? _____/day

14.2 Of the hours you spend at work how many hours you spend ☐

	Standing	Sitting	Walking	On activities more strenuous than walking

14.3 Describe the extent of movement and bodily exertion in <u>your spare time</u> during the last year. (From home to work regarded as spare time) <u>Select one</u>,

Read, watch TV or other sedentary activity…….. ☐

Walk, cycle or move about in some other way at least

<u>4 times per week</u> ……☐

(Includes walking, cycling to work, etc.)

Take part in physical exercise/ sport, do heavy gardening

(Note-activity must take place at least 4 times a week)…….☐

Exercise hard and take part in competitive sport

regularly and several times a week……☐

15. Family history

15.1 Has either of your parents or any of your siblings suffered from?

	Parents		Age of onset	Siblings		Age of onset
	Yes	No		Yes	No	
Angina pectoris						
Myocardial infarction						
Hypertension						
Diabetes mellitus						
Stroke/TIA						

16 Anthropometrics

Height (cm) _____

Weight (Kg) _____

Hip circumference (cm) _____

Waist circumference (cm) _____

17. Blood pressure (SBP/DBP)

1. _____
2. _____
3. _____

18 Blood sample Date of collection __/___/___

Time since last meal/drink _____ hours

Appendix III

Questionnaire of the Kandy Sinhalese study

Questionnaire

Cardiovascular disease risk factors among urban Sinhalese of Kandy

- **Serial number** ☐
- **Date (dd/mm)** ☐
- **Interviewer** ☐

General information

1. Name ……

2. Address ……

3. Sex ……

4. Date of birth ……

5. Place of birth ……

6. Religion ……

7. Years of education ……

8. Occupation

8.1 Are you currently employed?
Yes, full time ☐ Yes, part time ☐ No ☐

8.3 What is/was your occupation / title at this place of work?
(E.g. secretary, teacher, industrial worker, child nurse, head of department, salesmen, driver, etc.)
Occupation…….

8.4 In your main occupation, are you self employed, do you work as an employee or as a family member without an agreed fixed wage?
Self- employed ☐ Employee ☐ Family member ☐

8.5 What is your income? ……

8.6 What is the income of your household? ……

9 How many members are there in your family

Total number ☐ Adults ☐

Children under 18years ☐

9.1 How many children have you got? ☐

9.2 How old is the last child? ☐

10. Health

10.1 How would you describe your present state of health?

1. Poor
2. Not very good
3. Good
4. Very good

10.2 Do you have any of these illnesses or have you suffered from them in the past? Are you on treatment? How long? What type of treatment? Regularly?

.	Age Of onset	Suffered		On treatment		How long	What type of treatment		Regular treatment	
		Yes	No	Yes	No	Years	Allopathic	Ayurveda	Yes	No
❑ Diabetes										
❑ History of Hip/ wrist fracture										
❑ Cardiac infarction										
❑ Angina pectoris										
❑ Stroke/TIA										
❑ Hypertension										

10.3 Do you feel pain or discomfort in your chest when you: Walk up hills, climb stairs or walk fast on level ground? Yes ☐ No ☐

Do you get it when you walk at an ordinary pace on the level?

Yes ☐ No ☐

10.5 If you feel such pain, do you usually:

Stop? Yes ☐ No ☐

Slow down? Yes ☐ No ☐

Continue at the same pace? Yes ☐ No ☐

10.6 If you stop/slow down does the pain then disappear? Yes ☐ No ☐

10.7 If yes, after how long? 10 minutes or less ☐

More than 10 minutes ☐

10.8 Is such pain just as likely to occur when you are standing or sitting/lying down?

Yes ☐ No ☐

10.9 Have you ever had a severe pain across the front of your chest lasting for about half an hour or more? Yes ☐ No ☐

11. Body weight

11.1 Assess your weight when you were 25 years old. _____Kg

12. Smoking

12.2 Have you smoked/ do you smoke daily? Yes ☐ Yes earlier ☐ Never ☐

12.3 If you smoke daily at present, do you smoke?

- Cigarettes Yes ☐ No ☐
- Cigars Yes ☐ No ☐
- Beedee Yes ☐ No ☐
- Other Yes ☐ No ☐

12.4 If you have smoked daily before, how long is it since you stopped smoking?

Number of years……

If you smoke daily now, or have smoked daily before:

12.4 How many cigarettes do you or did you smoke daily? _____/day

12.5 How old were you when you started smoking daily? _____years

12.6 How many years altogether have you smoked daily? _____years

13. Food and drink

13.1

	Seldom/never	1-3 times per month	1-3 times per week	4-6 times per week	1-2 times per day	3 or more times per day
White Rice /white rice flour products						
Red Rice /red rice flour products						
Wheat flour products - Bread/Roti/						
Vegetable dishes that are cooked						
Raw vegetables/salad/greens						
Fruits/berries						
Pulses (cooked/boiled/wadai)						
Fish/Dried Fish						
Meat						
Deep Fried snacks (rolls, patties)						
Home made sweets/desserts						
Toffees/chocolates						

13.2 What kind of fat do you use usually?

	Dairy butter	Ghee	Hard margarine	Soft light margarine	Coconut/palm oil	Soya/ sun flower oil	Non
On bread/ Roti/hoppers/thosai							
For cooking							

How often?

	Seldom/never	1-3 times a month	1-3 times per week	4-6 times per week	1-2 times per day	3 times or more per day
On bread/ Roti/ hoppers/thosai						
For cooking						

13.3 How often do you use coconut in food?

	Seldom/never	1-3 times a month	1-3 times per week	4-6 times per week	1-2 times per day	3 times or more per day
Coconut flesh						
Coconut milk						

13.4 Do you take food supplements?

Yes, daily ☐ Sometimes ☐ No ☐

If yes what supplements? _____

13.5 How often do you drink of the following?

	Seldom/never	1-6 glasses per week	1 glass per day	2-3 glasses per day	4 glasses or more per day
Water					
Coca cola and likes					
Other carbonated drinks					

13.6 If you drink Cola and other carbonated thirst quenchers, do you usually use once

with sugar ☐ without sugar ☐

13.7 How many cups of tea or coffee do you drink daily?

Number cups tea ……. Number cups coffee …….

13.7.1 Do you take sugar with tea or coffee? Yes ☐ No ☐

13.7.2 If yes how many times? ……../day

13.7.3 If so how many teaspoons of sugar do you use each time? ……Tsps/day

13.7.4 Do you take milk / milk powder with tea or coffee? Yes☐ No ☐

13.7.5 If yes how many times a day? ……/day

13.7.6 If so how much each time?

Full cream milk powder……...Tsp

Non fat milk powder …….....Tsp

Milk ……..cups

13.8 How often have you consumed alcohol in the course of the past year? (Low alcohol beer and non alcoholic beer are not included)

4-7 times/ week	2-3 times/ week	Once/ week	2-3 times/ month	Once/ month	Few times last year	Have not drunk this past year	Have never drunk alcohol

To those who have consumed alcohol during the past year

13.9.1 When you consumed alcohol, how many glasses or drinks did you usually consume?

Number_____ (glasses ☐ Drinks ☐)

13.9.2 How often in the course of the past year did you drink as many as at least 5 glasses or drinks in the course of one day?

Number of times_____

13.9.3 When you drink do you usually drink:

Beer ☐ Wine ☐ Spirits ☐ Toddy ☐

14. Physical activity

14.1 On average how many hours a day do you spend at work? _____/day

14.2 Of the hours you spend at work how many hours you spend

Standing	Sitting	Walking	On activities more strenuous than walking
h	h	h	h

14.3 Describe the extent of movement and bodily exertion in your spare time during the last year. (From home to work regarded as spare time) Select one,

Read, watch TV or other sedentary activity…….. ☐

Walk, cycle or move about in some other way at least 4 times per week …… ☐
(Includes walking, cycling to work, etc.)

Take part in physical exercise/ sport, do heavy gardening
(Note-activity must take place at least 4 times a week)……. ☐

Exercise hard and take part in competitive sport regularly and several times a week…… ☐

15. Family history

15.1 Has either of your parents or any of your siblings suffered from?

	Parents		Age of onset	Siblings		Age of onset
	Yes	No		Yes	No	
Angina pectoris						
Myocardial infarction						
Hypertension						
Diabetes mellitus						
Stroke/TIA						

16 Anthropometrics

Height (cm) _____

Weight (Kg) _____

Hip circumference (cm) _____

Waist circumference (cm) _____

17. Blood pressure (SBP/DBP) 1. _____

2. _____

3. _____

18 Blood sample Date of collection __/___/___

Time since last meal/drink _____ hours

19 Urine sample Date of collection __/___/___

Appendix IV

Supplementary Questionnaire Oslo-selected sections

You may use this English form as a language guide, but please fill in the Norwegian form in the appropriate boxes.

Oslo Health Survey

I filled in:

Day ☐☐ Month ☐☐ Year ☐☐☐☐

I1. YOUR HEALTH

1.1 **During the past year have you been troubled by pain and/or stiffness in muscles and joints that has lasted at least 3 months?** ..... Yes ☐ No ☐

If "No", go to Item 1.6

1.2 **How long has the pain/ stiffness lasted in all?** Approx. ☐☐ years and ☐☐ months

1.3 **Has this reduced your work capacity during the past year?**
(Also applies to work in the home. Tick only one box)

No/insignificantly	Somewhat	Significantly	Don't know
☐1	☐2	☐3	☐4

1.4 **Have you been on sick leave because of this problem during the past year?** Yes ☐ No ☐ Not working ☐

1.5 **Has this problem cut down on your recreational activities?** ..... Yes ☐ No ☐

1.6 **Has your weight changed over the last 5 years?**

No/ insignificantly	A little up	A lot up	A little down	A lot down	A lot up and down
☐1	☐2	☐3	☐4	☐5	☐6

1.7 **How often do you have trouble sleeping?** *(Tick only one box)*

Never, or a few times a year ..... ☐1
1-3 times a month ..... ☐2
About once a week ..... ☐3
More than once a week ..... ☐4

1.8 **During the last year, has your trouble sleeping affected your capacity to work?** ..... Yes ☐ No ☐

1.9 **To what degree do the following vary with the seasons?**
(Either up or down, gets better or gets worse)
(Tick one box in each line)

	No change	Little change	Moderate change	Large change	Major change
Amount of sleep.....	☐	☐	☐	☐	☐
Social activities	☐	☐	☐	☐	☐
Mood/spirits	☐	☐	☐	☐	☐
Weight.....	☐	☐	☐	☐	☐
Appetite.....	☐	☐	☐	☐	☐
Initiative/drive/energy..	☐1	☐2	☐3	☐4	☐5

1.10 **If one or more of the above-mentioned states varies with the seasons, during which time of the year do you feel worst?**
(Tick one or more months)

January	February	March	April	May	June
☐	☐	☐	☐	☐	☐

July	August	September	October	November	December
☐	☐	☐	☐	☐	☐

1.11 **If any of the things mentioned in the questions above vary with the seasons, to what degree do you find this to be a problem?** *(Tick only one box)*

No problem	Slight degree	Moderate degree	Noticeable degree	Serious problem	Completely disabling
☐	☐	☐	☐	☐	☐

I2. DIET

What is important in this part is that you find an answer *that* your eating habits, even though it might not be totally accura

2.1 **How many times a week do you eat the following?**
(Tick one box for each line) *(t. = times)*

	Seldom/ never	1-2 t. a week	3-4 t. a week
First meal/food before 10.00 (eg. tea and biscuits, bread, crispbread, cereal, porridge soup, leftovers)	☐	☐	☐
Second meal/lunch (packed lunch, *parantha*, stuffed *naan*, salad, soup, rice dishes, leftovers)	☐	☐	☐
Third meal/dinner (meat dishes, vegetable dishes, rice dishes, pizza, soup)	☐	☐	☐
Fourth meal/evening (snacks, bread, leftovers).....	☐	☐	☐
Fifth meal (fruit, sweets)	☐1	☐2	☐3

2.2 **How many meals do you eat during a normal day?**

Number of warm meals ☐ Total number of meals ☐

2.3 **If you think about the dishes you normally eat for dinner, how would you describe them?**
(Tick one box that fits best)

Mostly Norwegian dishes ..... ☐1
Mixed, but mostly Norwegian dishes ..... ☐2
Mixed, but mostly dishes from native country ..... ☐3
Mostly dishes from native country..... ☐4

2.4 **How much bread do you usually eat during a normal day**
(Count all your meals. Put 0 beside what you don't eat daily)
(1 slice = 1/2 bun/ciabatta)

White bread *(including horn, white-bread buns, ciabatta etc.)* ..... *Number of slices* ☐

Dark or medium dark bread *(including dark buns)* ..... *Number of slices* ☐

Crispbread ..... *Number of pieces* ☐

2.5 **Do you spread butter, margarine or oil on your bread?**
(Tick one box only)

Daily	Occasionally	Almost never
☐1	☐2	☐3

2.6 **How often do you eat these types of food?**
(Tick one box for each line) *(t. = times)*

	Seldom/ never	1-2 t. a week	3-4 t. a week	5 a
Turkey, ham, light cold cuts	☐	☐	☐	
Kebab, fish fingers, leftovers w/meat, *patties*	☐	☐	☐	
Chutney/pickles/*shor*	☐	☐	☐	
Cheese (eg. yellow, brown, cream, cheese spread, homemade cheese)	☐	☐	☐	
Light cheese (eg. yellow, brown, cream, cheese spread, homemade cheese)	☐	☐	☐	
Sweet spreads (eg. jam				

I2. DIET(continued)

2.6 How often do you eat these types of food?
(Tick one box for each line)
(t. = times)

	Seldom/ never	1-2 t. a week	3-4 t. a week	5-7 t. a week	Several t. a day
Fish on sandwich (mackerel, tuna, sardines, herring, caviar)	☐	☐	☐	☐	☐
Egg (boiled, fried, scrambled)	☐	☐	☐	☐	☐
Leftovers (eg. lentils vegetables, *saag*)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

2.7 How often do you eat food sold at these places?
(Take away or eat there) *(Tick one box for each line)*
(t. = times)

	Seldom/ never	1-3 t. per mth.	1-2 t. a week	3-4 t. a week	5-7 t. a week
Canteen/cafeteria/lunch bar	☐	☐	☐	☐	☐
Restaurant	☐	☐	☐	☐	☐
Kiosk/fast-food outlet	☐	☐	☐	☐	☐
Café/coffee bar	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

2.8 How often do you eat the following?
(Tick one box for each line)
(t. = times)

	Seldom/ never	1-3 t. per mth.	1-2 t. a week	3-4 t. a week	5-7 t. a week
Grilled chicken	☐	☐	☐	☐	☐
Other dishes with chicken, hen or turkey	☐	☐	☐	☐	☐
Burger (hamburger, cheese-burger, meat patty, *kebab*)	☐	☐	☐	☐	☐
Hot dog	☐	☐	☐	☐	☐
Chicken/turkey hot dog	☐	☐	☐	☐	☐
Pizza	☐	☐	☐	☐	☐
Other dishes with meat	☐	☐	☐	☐	☐
Other dishes with fish	☐	☐	☐	☐	☐
Other dishes with seafood	☐	☐	☐	☐	☐
Dishes with lentils and beans	☐	☐	☐	☐	☐
French fries/chips	☐	☐	☐	☐	☐
Potato dishes (eg. *aloo-parantha, salen*)	☐	☐	☐	☐	☐
Vegetable dishes (eg. *sabzi*, stews)	☐	☐	☐	☐	☐
Liver, kidney, heart etc.	☐	☐	☐	☐	☐
Noodles/soup	☐	☐	☐	☐	☐
Spaghetti, macaroni, pasta	☐	☐	☐	☐	☐
Rice	☐	☐	☐	☐	☐
Couscous, bulgur *(crack. wheat)*	☐	☐	☐	☐	☐
Chapatti *(non-yeast Asian bread)*	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

2.9 How often do you eat dinner prepared in these various ways?
(Tick one box for each line)
(t. = times)

	Seldom/ never	1-3 t. per mth.	1-2 t. a week	3-4 t. a week	5-7 t. a week
Ingredients fried first and then boiled in a stew	☐	☐	☐	☐	☐
Fried in pan with fat	☐	☐	☐	☐	☐
Broiled in oven or grilled	☐	☐	☐	☐	☐
Prepared in wok/*kadai*	☐	☐	☐	☐	☐
Only boiled or steamed (incl. boiled stews and soups)	☐	☐	☐	☐	☐
Deep-fried	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

2.10 How often do you eat these types of sauce/dressing?
(Tick one box for each line)
(t. = times)

	Seldom/ never	1-3 t. per mth.	1-2 t. a week	3-4 t. a week	5-7 t. a week
Thousand Island dressing etc.	☐	☐	☐	☐	☐
Ketchup	☐	☐	☐	☐	☐

I2. DIET (continued)

2.11 How many of your hot meals are without meat, chicken or fish during a normal week? *(Tick one box only)*

Seldom/ never	1-2 t. a week	3-4 t. a week	5-6 t. a week	Daily
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

2.12 How large a proportion of the whole meal is the basic fo (rice, chapatti, potatoes)? *(Tick one box only)*

1/4 basic food	1/2 basic food	3/4 basic food	Little no ba food
☐ 1	☐ 2	☐ 3	☐

2.13 How much soda pop/concentrates do you normally drink
(Tick one box for each line)
(1/2 litre = 3 glasses)

	Seldom/ never	1-6 gl. a week	1 gl. a day	2-3 gl. a day	4 m
Concentrate and other sweet drinks (eg. *sherbet, lassi*)	☐	☐	☐	☐	
Artificially sweetened concentrate	☐ 1	☐ 2	☐ 3	☐ 4	

2.14 Do you use normal sugar or sweeteners (*suketter*) in you

Yes ☐ No ☐

If "Yes" :
Estimate how much you use in all during a normal day.
(Put 0 on what you don't use)

Number of sugar cubes a day	Number of spoons of sugar a day	Number of sweet a day
☐☐	☐☐	☐☐

2.15 How often do you eat these types of food?
(Tick one box for each line)
(t. = times)

	Seldom/ never	1-3 t. per mth.	1-2 t. a week	3-4 t a w
Danish pastry	☐	☐	☐	☐
Sweet roll, cinnamon buns etc.	☐	☐	☐	☐
Sweet biscuits	☐	☐	☐	☐
Cookies, waffles, doughnuts	☐	☐	☐	☐
Chocolate, sweets	☐	☐	☐	☐
Dried fruit (eg. raisins, figs, dates, almonds, peanuts)	☐	☐	☐	☐
Salted snacks, light	☐	☐	☐	☐
Salted snacks, normal	☐	☐	☐	☐
Ice-cream	☐	☐	☐	☐
Desserts (*Halwa, bakalawa, khir,* pudding etc.)	☐	☐	☐	☐
Yoghurt	☐	☐	☐	☐
Oatmeal porridge, cereals, cornflakes	☐	☐	☐	☐
Olives	☐	☐	☐	☐
Spring rolls, samosa, kofta	☐	☐	☐	☐
Sweet snacks (*mithai, jalebi etc.*)	☐	☐	☐	☐
Sunflower seeds/ melon seeds	☐ 1	☐ 2	☐ 3	☐ 4

2.16 How often do you/your household use these goods to ma
(For frying, baking, in sauces or in dishes)
(Tick one box for each line)
(t. = times)

	Seldom/ never	1-3 t. per mth.	1-2 t. a week	3-4 t. a we
Hard margarine	☐	☐	☐	☐
Soft margarine (doesn't get hard in the fridge)	☐	☐	☐	☐
Butter	☐	☐	☐	☐
Coconut fat/coconut milk	☐	☐	☐	☐
Buttermilk/ yoghurt	☐	☐	☐	☐
Oils	☐	☐	☐	☐

I2. DIET (continued)

2.17 **Are you satisfied with your weight?** ..... Yes ☐ No ☐

If No:
What weight would you be satisfied with? (ideal weight) ? ..... ☐☐☐ *whole kg*

Have you tried to lose weight during the last year? ..... Yes ☐ No ☐

2.18 **Have any of the conditions below limited the opportunities you have to buy the food you prefer?** *(Tick one box for each line)*

	Very large deg.	Fairly large deg.	Fairly little degree	Very little degree
Poor availability	☐	☐	☐	☐
Poor quality	☐	☐	☐	☐
Too expensive.....	☐ 1	☐ 2	☐ 3	☐ 4

2.19 **Do you use the new "Extra light" 2% (light) milk** *(with vitamin D)*?

Yes ☐1 **No/don't like milk** ☐2

(2 % = *"Lett melk"*)

If "Yes":
Do you use this: *(Tick one or more boxes)*

Instead of whole milk	Instead of 2% milk	Instead of skimmed milk	Other
☐	☐	☐	☐

2.20 **If you have moved to Norway, have you changed your consumption of these types of food since you came to Norway?** *(Tick one box for each line)*

	Use more	Use less	Same as in native country
Milk	☐	☐	☐
Yoghurt	☐	☐	☐
Butter.....	☐	☐	☐
Margarine.....	☐	☐	☐
Oil	☐	☐	☐
Meat	☐	☐	☐
Fish	☐	☐	☐
Lentils/beans	☐	☐	☐
Boiled potatoes	☐	☐	☐
Vegetables	☐	☐	☐
Fruit	☐ 1	☐ 2	☐ 3

I3. ILLNESS IN THE FAMILY

3.1 **Tick the relatives who have or have had any of the illnes** *(Tick one box for each line)*

	Mother	Father	Brother	Siste
Stroke/cerebral haemorrhage	☐	☐	☐	☐
Heart attack before 60 years of age	☐	☐	☐	☐
Asthma	☐	☐	☐	☐
Cancer.....	☐	☐	☐	☐
Diabetes	☐ 1	☐ 2	☐ 3	☐ 4

3.2 **If any of your relatives have diabetes, at what age did they develop it?**

Don't know not applicable	Mother's age	Father's age	Brother's age	Sister's age	Cl a
☐	☐☐	☐☐	☐☐	☐☐	☐

3.3 **Do you have old, chronically ill or handicapped family members in your care ?** Yes ☐

If "No"; go straight to 4.1
If "Yes":
Who is in your care? *(Tick one or more boxes)*

Child ..... ☐
Spouse/cohabitant..... ☐
Brother/sister..... ☐
Parent(s)/parent(s)-in-law ..... ☐
Other ..... ☐

Does this affect your health *(tick one box only)*

Yes, a lot	Yes, somewhat	Just a little bit
☐1	☐2	☐3

3.4 **Is home help or home nursing available to you or your family to the extent that you want it?** Yes ☐

I4. MEDICAL SERVICES

4.1 **How many doctors have you been to in the course of the last 12 months, not including treatment in hospital or outpatient clinic?** *Number of doctors*
If you have not been to a doctor write 0.

4.2 **What type of doctor (excluding hospital and outpatient cl did you last visit?**

General Practitioner (GP) ☐1 Specialist ☐2

4.3 **How satisfied were you with your last visit to a doctor? (excluding hospital and outpatient clinic)?** *(Tick one box*

Very satisfied	Fairly satisfied	Not sa
☐1	☐2	☐

I2. DIET (continued)

2.21 **What time of the day did you eat yesterday?** *(from 6 o'clock in the morning until 5 o'clock in the morning the next day). Tick the first box if y*
not eat one of the alternatives.
(Tick at least one or more box per line)

	Didn't eat this	Time of day (from morning to evening and into the night) 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 01 02 03 04 05
Bread meals *(eg. bread slices/* sandwich, crispbread, *cereals)*	☐	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Light meal *(eg. khir, raita with potatoes, beans and vegetables, salad, soup, omelette, a slice of pizza)*	☐	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Big meal *(eg. dinner, hamburger w/chips and salad)*	☐	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Sweet snacks *(eg. cake,* biscuits, *chocolate, sweets)*	☐	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Salted snacks *(eg. crisps, nuts)*	☐	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Fruit or vegetable snacks	☐	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐