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Physical activity, cardiorespiratory fitness and CVD risk factors in a group of Pakistani immigrant men living in Norway – effects of a randomized controlled physical activity intervention

The Physical Activity and Minority Health Study

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To my wife

Summary

Background

Pakistani immigrants living in Norway have a high risk of major lifestyle diseases, and increased physical activity (PA) seems to be a crucial preventive measure. Their level of PA seems to be low, possibly explaining in part the high prevalence of type 2 diabetes (T2D) and cardiovascular diseases (CVD) in this group. Thus, the overarching goals of the study were to find an effective way to encourage this group of immigrants to be more physically active and to investigate to what extent increased PA might influence risk factors for T2D and CVD.

Aim

To describe objectively the levels of PA, cardiorespiratory fitness (CRF) and CVD risk factors in a group of Pakistani immigrant men living in Norway, and to investigate the short-term (follow-up 1: conducted immediately after the intervention) and long-term (follow-up 2: conducted six months after the intervention) effects of a social cognitive theory (SCT) based multicomponent PA programme on the levels of PA, CRF and CVD risk factors.

Methods

A total of 150 Pakistani immigrant men (mean age 37.3 years ± SD 7.7) living in Oslo, Norway, were randomly allocated to either a control or an intervention group. The intervention was developed in collaboration with the Pakistani community. The intervention used an SCT framework and comprised structured supervised group exercises, group lectures, an individual counselling session and a telephone call. The five-month intervention focused on increasing levels of PA, which were assessed with accelerometers. Peak oxygen uptake was measured directly during a continuous progressive treadmill protocol in which the men ran until exhaustion. Fasting and postprandial blood samples were drawn and analysed to measure the concentrations of glucose, insulin, C-peptide, HbA_{1c} and lipids. Waist circumference, body mass index (BMI), blood pressure, diet and potential psychosocial mediators of PA were recorded. Six months after the intervention, a follow-up study was conducted to investigate the long-term effects of the intervention.

Main results

The cross-sectional data confirmed the high CVD risk in this group as shown by the low level of PA, low peak oxygen uptake, and high prevalence of the metabolic syndrome, obesity and insulin resistance, especially among taxi drivers. The intervention significantly increased both the short- and long-term PA level. Although social support for PA and outcome expectancies increased significantly, the factors mediating the change in PA could not be identified. The intervention improved peak oxygen uptake, insulin and C-peptide concentrations, BMI and waist circumference in the intervention group compared with the control group. The prevalence of the metabolic syndrome and related factors did not differ between the groups at follow-up 1. Increased PA level was associated with beneficial changes in plasma insulin concentration after adjusting for waist circumference.

Conclusions

Levels of PA and CRF are low, and risk factors for CVD are high among Pakistani immigrant men living in Oslo, Norway. An SCT based multicomponent PA programme with Pakistani immigrant men beneficially influenced the PA level both in the short- and long-term, and may thereby reduce their long-term risk of developing T2D and CVD.

Keywords

Pakistani immigrant men, physical activity, cardiorespiratory fitness, cardiovascular diseases, diabetes, metabolic syndrome, social cognitive theory, accelerometer, randomized controlled trial.

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"pappa skal vi slåss?" "Jepp".

Oslo, August 2011
Eivind Andersen

List of papers

The dissertation is based on the following original research papers, which are referred to in the text by their Roman numerals:

I. Eivind Andersen, Arne Torbjørn Høstmark, Catherine Lorentzen, Sigmund Alfred Anderssen. Low level of objectively measured physical activity and cardiorespiratory fitness, and high prevalence of metabolic syndrome among Pakistani male immigrants in Oslo, Norway. *Norsk Epidemiologi 2011; 20 (2): 199-208*

II. Andersen E, Høstmark AT, Holme I, Anderssen SA. Intervention effects on physical activity and insulin levels in Pakistani immigrant men living in Oslo: a randomised controlled trial. *Submitted to Diabetes Research and Clinical Practice.*

III. Andersen E, Høstmark AT, Anderssen SA. Effect of a physical activity intervention on the metabolic syndrome in Pakistani immigrant men: a randomised controlled trial. *In press in Journal of Immigrant and Minority Health.*

IV. Physical activity level were maintained six months after a randomised controlled physical activity intervention – a follow-up study on Pakistani immigrant men living in Norway. *Accepted in International Journal of Behavioral Nutrition and Physical Activity.*

Abbreviations

ACSM	American college of sport medicine
BMI	Body mass index
BP	Blood pressure
CHD	Coronary heart disease
CI	Confidence interval
CPM	Counts per min
CRF	Cardiorespiratory fitness
CVD	Cardiovascular diseases
DBP	Diastolic blood pressure
EE	Energy expenditure
FFA	Free fatty acids
GLUT	Glucose transporter
HbA_{1c}	Glycosylated haemoglobin
HDLc	High density lipoprotein cholesterol
HOMA-IR	Homeostasis model assessment-insulin resistance
IDF	International diabetes federation
IGT	Impaired glucose tolerance
LDLc	Low density lipoprotein cholesterol
MET	Metabolic equivalent
MetS	Metabolic syndrome
MVPA	Moderate to vigorous physical activity
PA	Physical activity
PAEE	Physical activity energy expenditure
PAMH	Physical activity and minority health
RCT	Randomised controlled trial
RMR	Resting metabolic rate
SBP	Systolic blood pressure
SCT	Social cognitive theory
SD	Standard deviation
SES	Socioeconomic status
TG	Triglyceride
T2D	Type 2 diabetes
VLDLc	Very low density lipoprotein cholesterol
VO_{2max}	Maximal oxygen uptake
VO_{2peak}	Peak oxygen uptake
WHO	World Health Organisation

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Background

The Norwegian immigrant population has been growing rapidly the past 50 years. The immigrants, those who have migrated (immigrants or first-generation immigrants) and their children (Norwegian-born with immigrant parents or second-generation immigrants), come from 215 different countries and comprise 12% of the total population. The immigrant population is projected to increase to between 22% and 28% of the Norwegian population by 2060 [1]. Oslo is considered a multi-ethnic city, and 28% (170 200) of the people living there are defined as an immigrant [2]. Immigrants are classified broadly into Western and non-Western immigrants (from Asia, Africa and Latin America). Asia is further subdivided into five geographical regions including the Indian subcontinent or South Asia (Pakistan, India, Sri Lanka, Nepal and Bangladesh). One-third of the immigrants in Norway have an Asian background, and include 31 000 Pakistanis [2].

The Pakistanis first came to Norway as unskilled workers in the 1960s. Now, most of the Pakistanis who settle in Norway have come through family reunion or marriage. Three of four find a spouse from Pakistan. Eighty-five per cent of the Pakistanis live in Oslo or Akershus, and 30% have lived here for more than 25 years. On average, the Pakistanis have a low education level, although the second generation completes higher education to a similar extent as the general population. Employment rates were 60% for men and 28% for women in 2005 compared with 69.4% in the general population [3]. According to calculations from Statistics Norway, Pakistani men are 4.3 times more likely to work in either the transport/communication or hotel/restaurant fields compared with the general population [3]. Forty-four per cent are employed in one of these occupations. The average income for the Pakistanis is much lower than in the general population [3].

The different cultures, traditions and beliefs of immigrants enrich and complement the Norwegian people and culture. The downside is the high prevalence of some non-communicable diseases, especially among South Asians [4-6], which is a major burden for them and a huge challenge for the government health agencies. In the battle against these diseases, increasing the observed low physical activity (PA) level is believed to be a powerful weapon. The question then is what effect PA has on important health outcomes in this group and how we as health professionals can help make PA a natural part of their lives.

Introduction

According to the World Health Organization (WHO), cardiovascular diseases (CVD) are the world's biggest killer, claiming more lives than any other cause [7]. Having type 2 diabetes (T2D) [8] and the metabolic syndrome (MetS) [9] increases the risk of developing CVD. Furthermore while a sedentary lifestyle increases the risk of developing these non-communicable diseases [10], a physically active lifestyle seems to be protective [11, 12]. South Asians may be especially vulnerable to these diseases [13]. The mechanisms behind the excessive risk among South Asians have not been elucidated, but a low PA level may be an important factor [14]. This introduction will first give a short description of the basics of PA and cardiorespiratory fitness (CRF), selected methods to assess these and a description of the PA level in South Asian immigrants in Norway and other Western countries. Next, a brief overview of CVD and its most influential risk factors, and how these are manifested in the South Asian immigrants will be presented. Thirdly the effect of PA upon CVD and CVD risk factors both in the general population and more specifically in the South Asians will be discussed. Finally, the introduction describes PA interventions that attempted to increase PA level in South Asian immigrants and the use of social cognitive theory (SCT) in PA research.

Most studies conducted on South Asians do not discriminate between the different ethnicities, (defined as "the social group a person belongs to, and either identifies with or is identified with by others, as a result of a mix of cultural and other factors including one or more of language, diet, religion, ancestry, and physically features traditionally associated with race" [15]) although one should recognize the heterogeneity of this group with respect to important differences in PA, diet, culture, beliefs and lifestyle. Thus, when investigating ethnic differences in e.g., health, the term South Asian may be imprecise [16]. However, because there are only a few studies on Pakistanis in this field, and although there are many differences within the South Asian group, one should also recognize the many similarities (e.g., geographical). Thus, studies on South Asians, which often but not always include Pakistanis, and Asian Indians are also included. Studies comparing South Asians to Caucasians (Europeans or other lighter-skinned populations) often use different terms (e.g., white, Western, Europeans). The term used by the respective authors will be used when referring to the relevant studies.

Physical activity and cardiorespiratory fitness

Definition and basic principles

Physical activity

PA is defined as any bodily movement produced by the skeletal muscles that requires energy expenditure [17]. PA is a complex behaviour that includes movement of the body during leisure time, transportation or commuting, compulsory physical education, household and labour. Exercise is PA that is planned, structured and repetitive with the purpose of improving or maintaining one`s physical fitness [17]. The total volume of PA that a person undertakes in a given unit of time is the sum of the different PA dimensions including duration (units of time), frequency (number of occurrences of a repeating event per unit of time) and intensity. The intensity of PA is often described in metabolic equivalents (METs), where one MET is equivalent to the resting metabolic rate (RMR) (oxygen uptake of 3.5 $ml \cdot kg^{-1} \cdot min^{-1}$). The MET of PA tasks is a physiological concept to express the energy cost of the activity as multiples of RMR. Sedentary behaviour is defined as a MET of 1.5 or less (e.g., sitting, lying down) [18], light PA as a MET between 1.6 and 2.9 (e.g., slow walking, washing dishes) [18], moderate PA as 3 to 6 METs (e.g., brisk walking) and vigorous PA or very vigorous intensity PA as more than 6 METs (e.g., jogging, vigorous PA; running, very vigorous PA).

Physical fitness

Physical fitness is a set of attributes that are either health or skill related [17]. Health-related fitness comprises those components of physical fitness that have a relationship with good health and includes cardiorespiratory endurance, muscular endurance, muscular strength, body composition and flexibility. Skill-related fitness includes those components of physical fitness that have a relationship with enhanced performance in sports and motor skills, and includes agility, balance, coordination, speed, power and reaction time. Cardiorespiratory endurance, now more commonly termed CRF or aerobic fitness, can be defined as "a health-related component of physical fitness that relates to the ability of the circulatory and respiratory systems to supply fuel during sustained PA and to eliminate fatigue products after supplying fuel" [17]. Because of the strong relationship with health [19-21], CRF is the main component of physical fitness that this thesis focuses on. The CRF level is highly dependent upon the PA level [22], sex [23] and age [23-25]. Genetic contributions to CRF are important, but probably account for less of the variation in fitness than does PA participation [26].

Assessment of physical activity and cardiorespiratory fitness

Over the past few decades, our understanding of the beneficial effects of PA has evolved along with the development of subtle methods for assessing this behaviour. With the development of valid and reliable methods, researchers can now address complex research questions and assess the effectiveness of interventions designed to promote PA, quantify the optimal dose of PA required to obtain good health, monitor the PA level in a population, detect changes over time and identify psychosocial and environmental mediators of PA.

Assessment of physical activity

There is a wide range of different methods to assess PA, and these are normally categorized into two groups: subjective and objective methods. Each of the different techniques has advantages and disadvantages that one must consider when selecting an instrument. Using an inaccurate method to assess PA can result in an under- or overestimation of the true exposure [27]. The method chosen depends on the specific research question, resources available, population studied and practical limitations. A combination of methods may sometimes be warranted [28]. Ideally, PA should be assessed over a period long enough to be representative of the individual`s habitual PA level and be of minimal discomfort to the person. The many methods available, and used, suggest that no single method can fully assess all aspects of PA behaviour and PA-related energy cost. Hence, many of the challenges in measuring free-living PA remain despite major advances in technology.

Subjective methods include diaries and questionnaires. Questionnaires are the most commonly used method to assess PA and have contributed much to the PA literature. The subjective methods differ from the objective methods in that they rely completely on the respondent's ability to provide information on his or her own PA behaviour. The advantages of questionnaires are that they are relatively inexpensive, easy to administer, pose a low burden to the participant, capture both quantitative and qualitative information and the existence of a PA compendium to estimate the energy expenditure (EE) of activities of daily living. However, the limitations of using self-report techniques to assess PA have been well documented [29]. Participants may have difficulty recalling PA, and validity problems associated with misinterpretation of PA in immigrants have been reported [30]. It is also difficult to obtain a precise description of the PA intensity, activity pattern during the day and differences between weekdays and weekends using existing questionnaires.

Objective methods include direct observation, calorimetry, physiological markers and motion sensors. *Direct observation* is often considered the “gold standard” for PA assessment. Direct observation provides good quantitative and qualitative information on the PA behaviour and exceeds other measures of PA by providing contextually rich data. Recall bias associated with self-report and lack of information on the activity context when used with accelerometers can be avoided. Direct observation is often used to understand how PA is influenced by the physical and social environments, but may not be applicable to a large sample size because of the time-intensive data collection. Doubly labeled water is considered the “gold standard” for measuring EE under free-living conditions, but has a high relative cost and is an invasive procedure.

Accelerometers are now commonly used devices for measuring free-living PA. Accelerometers are small and non-invasive, and provide a valid estimate of overall PA (frequency, intensity and duration) [31], but they do not capture the type or purpose of specific activities, which are important information in behavioural research. A major advantage over the subjective methods is that accelerometers are almost free from random and systematic errors introduced by respondents [32]. Accelerometers have been shown to give more precise PA data than questionnaires [32]. In addition, in a study of Pakistani immigrant women in Norway (n = 86), accelerometer recorded PA was associated with many physiological variables (blood concentrations of glucose, insulin and lipids, and waist circumference); no such association was found with subjective measures of PA [33]. This suggests that accelerometers may reduce the sample size needed in PA studies [32]. There are many types of accelerometers available commercially, and the most commonly used is the model 7164 developed by ActiGraph. ActiGraph accelerometers have been found to have good intra- and inter-instrument reliability, although large variations have been noted at very low and very high accelerations [34].

Accelerometers continuously measure body movements in terms of acceleration (m·s^2), often expressed as a count value. Usually, the sum of acceleration in a given time period (epoch) is presented as mean counts·min^{-1} (CPM). The high frequency of sampling allows researchers to quantify the intensity and amount of PA precisely. The acceleration is measured by piezoelectric or seismic sensors in one (vertical), two (vertical and medial-lateral), or three (vertical, medial-lateral and anterior-posterior) dimensions. Research has shown that activity counts from uniaxial and triaxial accelerometers strongly correlate (r = 0.91) [35].

An accelerometer is normally attached to the hip or lower back to place it as close as possible to the body's centre of mass [36]. Therefore, accelerometers do not adequately capture upper-body movement [37] such as lifting weights, carrying a load and rowing, in addition it do not adequately capture the energy cost of cycling. Although acceleration, or CPM, rises linearly with speed of walking up to 9 km·h^{-1} (r = 0.92), CPM level off at about 10 000 during running at speeds > 9 km·h^{-1} [38]. Measurement accuracy is limited if the sensor is positioned at an angle, which may happen more often in the overweight or obese [39]. Most accelerometers are not waterproof, and therefore cannot measure activities in water.

In theory, EE is related to the acceleration of the body mass and the body mass being accelerated. To translate counts into more physiologically meaningful information, the association between accelerometer counts and oxygen consumption during specific activities has been studied. Most accelerometers show good to very good correlations (r = 0.88) with EE during walking and running [40] but underestimate the energy cost of running at > 9 km·h^{-1}, cycling, rowing and upper-body movement [38]. Activity counts from the ActiGraph accelerometer also correlate well (r = 0.30 to 0.96) with EE of PA (PAEE) measured using the doubly labeled water method [41]. To measure time spent at different PA intensities, different activity cut points have been determined from regression modelling that relate CPM to EE in METs. There is no consensus on which cut points to use because no single equation accurately measures free-living PAEE, and it has been proposed that accelerometers should not be used to predict PAEE [42]. The most commonly used cut points are derived from the study by Freedson et al. [40], which were also used in the current study.

Assessment of cardiorespiratory fitness

The most reliable and valid measure of CRF is the direct measurement of oxygen uptake during a maximal exercise test on either a treadmill or a stationary bicycle [29]. The highest level of oxygen uptake obtained through such a test is called the maximal oxygen uptake (VO_{2max}) and is usually expressed either as an absolute rate (i.e., $L \cdot min^{-1}$) or relative to body weight (i.e., $mL \cdot min^{-1} \cdot kg^{-1}$). There is no consensus for identifying the precise point of VO_{2max} but the criteria used most often are a flattening of VO_2 with increasing work load (< 2.1 $mL \cdot kg^{-1} \cdot min^{-1}$) [43], respiratory exchange ratio > 1.1 [44], peak heart rate ± 10% of 220÷age, and post-exercise lactate concentration > 8.0 $mmol \cdot L^{-1}$ [45]. Peak oxygen uptake (peak VO_2) is the highest rate of oxygen consumption observed during an exhaustive exercise test and is often used in studies where there is uncertainty whether the participant has fulfilled the strict criteria for a VO_{2max} result. Peak VO_2 was used in this study. Direct measurement of CRF is a relatively costly, time-consuming and complex procedure, but a variety of less complex procedures have been developed to estimate VO_{2max} (indirect methods). Examples of indirect tests are the Andersen test [46] and the 20 m shuttle run test [47]. Although indirect methods have some practical advantages, they are less accurate than direct methods [29].

Physical activity recommendations

The Norwegian health authorities recommend that to maintain good health, one should engage in a minimum of 30 min of moderate- to vigorous-intensity PA (MVPA) (EE ≈ 150 kcal) on most days of the week (the 30 min can be split into three bouts of 10 min), or 2-3 sessions of 1 h of vigorous-intensity PA [48]. These recommendations should not be interpreted as a precise cut-off for good or bad health, because the relationship is continuous and not linear, and some health benefits can be achieved at lower PA levels and even more can be gained from increased levels [48]. The effect of PA is also dependent on individual responses to PA, the health status of the person, and the type of health outcome assessed. PA recommendations were first issued by the American College of Sports Medicine (ACSM) in 1978 [49] and have been revised several times. The recommendations published by the ASCM in 1978 are similar to the present recommendations, although there has been a shift away from vigorous-intensity PA to a stronger focus on moderate-intensity PA. The current recommendations are based mostly on studies where the investigators have used subjective measurements of PA (questionnaires), and it is likely that the recommendations will be adjusted further after publication of more accelerometer-based studies. Although governments PA recommendations are relatively new, a medical document written in Indian between 1000 B.C. and 800 B.C. recommended PA in the treatment of rheumatism. The Greek gymnast Herodicus (5th century B.C.) prescribed therapeutic exercise. The “father of preventive medicine” Hippocrates wrote extensively about the benefits of PA and recommended walking and other forms of MVPA, and criticized Herodicus for prescribing exercise that was too strenuous [50].

Most studies show an inverse gradient across fitness categories for various health outcomes [26], although no recommendations for CRF levels have been published. In a recent paper from Norway, peak VO_2 levels were measured in 4631 participants. The men with peak VO_2 levels below the median of 44.2 $mL \cdot kg^{-1} \cdot min^{-1}$ were eight times (odds ratio (OR) 7.9, 95% confidence interval (CI) = 3.5 to 18.0) more likely to have a cluster of CVD risk factors compared with those in the highest quartile of peak VO_2 ($\geq$ 50 $mL \cdot kg^{-1} \cdot min^{-1}$) when adjusted for age, PA and smoking [23].

Physical activity level in South Asian immigrants

Two studies in Norway suggested that South Asian immigrants have a lower PA level compared with ethnic Norwegians. In a study that combined the data from the Oslo Immigrant Health Study and the Oslo Health Study, which included 419 middle-aged Pakistani men and 4985 ethnic Norwegians, 55% of the Pakistani men reported to be physically inactive compared with 22% of the ethnic Norwegians [6]. In the Romsås in Motion study, 57% of the middle-aged South Asian men (n = 121) were classified as being sedentary in their leisure time compared with 32.5% of the Western men ($P < 0.05$) [4].

A low PA level has also been shown among immigrants from South Asia in the UK [51-53], New Zealand [54], North America [55, 56], Australia [57] and Canada [58]. In the study by Williams et al. [52], which used data from the Health Survey for England and included 5421 South Asians and 8974 white participants aged 18 to 55 years, the PA level was about 60% lower in South Asians than in whites. The South Asians were 60% less likely to comply with the current PA guidelines, even after adjustment for socio-economic factors. The authors concluded that the ethnic differences in PA are not specific to certain ages and persist across generations. A systematic review of 12 studies on adults and five studies on children performed in the UK, which included and described PA levels among South Asian immigrants, found similar results [30]. All of the studies reviewed reported lower levels of PA in South Asians compared with the general population ("whites" or "Europeans"). The differences between the groups were substantial: the PA level was 50% to 75% lower in South Asians than in Europeans.

In all of the above-mentioned studies, PA data were collected using either self-administered questionnaires or face-to-face interviews. These methods have certain weaknesses. Immigrants may find it difficult to complete questions that are not presented in their mother tongue and they might have different perceptions about the term "physical activity". In addition, the questionnaires used are often not tested for validity when applied to immigrant populations. The use of non-validated questionnaires in these studies suggests the need for caution when interpreting the results. Nonetheless, the large differences in the PA levels reported in these studies and the consistency of the results suggest that the PA level is lower among South Asian immigrants [52].

Cardiovascular diseases and CVD risk factors

CVD are a group of disorders of the heart and blood vessels. These diseases include coronary heart disease (CHD), cerebrovascular disease and peripheral arterial disease. CVD is the number one cause of death globally. It has been estimated that 17.1 million people died from CVD in 2004, most due to CHD and stroke [7]. CVD such as CHD and stroke are caused mainly by the accumulation of lipids, first intracellularly, and then extracellularly which form a fatty streak and eventually a lipid core that becomes isolated by the progressive formation of a fibrous cap, a process called atherosclerosis. The key event is the rupture of the plaque, which results in either partial or complete occlusive thrombosis. A blood clot, or thrombus, situated in the coronary arteries could cause either angina pectoris or myocardial infarction. Having diabetes and/or the MetS increases the risk of developing CVD [8]. Being overweight is also an independent long-term predictor of CVD mortality, even after adjustment for physical fitness [59]. Other known risk factors for CVD include physical inactivity [60], low CRF [61], poor diet, tobacco use, stress, alcohol use, being male, increasing age and heredity (including race) [62].

Diabetes

Diabetes, defined as having a fasting blood glucose level ≥ 7 mmol·L^{-1} or a postprandial glucose level ≥ 11.1 mmol·L^{-1} [63], is a non-communicable disease that occurs when the pancreas fails to produce enough insulin or when the body cannot efficiently use the insulin that is produced. A defect in insulin action includes reduced ability to suppress glucose secretion in the liver and to mediate glucose uptake and metabolism in cells (e.g., muscle cells). A long-term defect in insulin action may lead to the development of hyperglycaemia and eventually diabetes. Approximately 75% to 80% of those with diabetes die from CVD [8], and people with diabetes have a two to four times greater risk of CHD compared with the rest of the population [8]. Persons with T2D are believed to pass through a prediabetes stage, which is also associated with an increased risk of CVD [8]. The long-term complications of diabetes also include damage to the eyes, kidneys and nerves, and risk of amputation. People with diabetes may also have increased risk of developing hypertension and dyslipidaemia. It has been estimated that 171 million people around the world had T2D in the year 2000 and that the number of people with T2D is expected to approximately double between 2000 and 2030 [64]. The largest absolute increase in the number of people with diabetes will be in urban districts in India [64]. A systematic analysis of diabetes data from 199 countries and territories with 2.7 million participants showed that the prevalence of hyperglycaemia and diabetes is a rising global hazard: the number of people with diabetes has more than doubled in the past three decades from 153 million in 1980 to 347 million in 2008 [65]. Most of this increase in diabetes prevalence is attributable to population growth and ageing, but 30% is attributed to a rise in age-specific prevalence.

The metabolic syndrome

The MetS is a clustering of interrelated metabolic risk factors for CVD [66, 67] and T2D [68], and serves as a valuable screening tool to identify people at high risk. In the DECODE study on European men and women, people with the MetS had an increased risk of death from all causes as well as CVD [69]. The prevalence of the MetS has increased worldwide in past decades [9] and is associated with the global epidemic of obesity and T2D [68]. Physical inactivity is closely linked to the MetS, and Professor Steven N. Blair proposed that the MetS should be called the “physical inactivity syndrome” [70]. Prevalence rates vary from 8% among men in India to 24% in Americans [9]. Sub-analyses shows that the incidence of the MetS increases with age [71] and body mass index (BMI) levels [72], and is higher in some ethnic groups [73]. Many definitions of the MetS exist [74] but all include obesity, dyslipidaemia and hypertension, which are all independent factors related to CVD. The definition by the International Diabetes Federation (IDF) was used in this thesis because it is ethnic specific [72]. According to the IDF definition, men must have central obesity, defined as waist circumference with ethnic-specific values (≥ 90 cm for South Asians) plus any two of the following four factors:

- Serum triglyceride (TG) concentration ≥ 1.7 mmol·L^{-1}
- High density lipoprotein cholesterol (HDLc) concentration ≤ 1.03 mmol·L^{-1}
- Systolic blood pressure (SBP) ≥ 130 mmHg or diastolic blood pressure (DBP) ≥85 mmHg
- Fasting plasma glucose concentration ≥ 5.6 mmol·L^{-1}.

The IDF recognizes insulin resistance (IR) as an important component of the MetS but does not include it in the definition because it is difficult to measure in clinical practice [72].

Physical inactivity – sedentary behaviour

The regions that have had the highest incidence rates of CVD and T2D are those that have experienced rapid and major changes in diet and reductions in PA with concurrent increases in the prevalence of overweight and obesity [68]. Genetic traits have a significant impact on CVD risk, but this is beyond the scope of this thesis and will not be discussed further. Lack of PAEE and the availability of energy-dense food, which lead to overweight and obesity, might be a factor driving in the increased prevalence of CVD. An abundance of metabolically active visceral fat might be accompanied by elevated levels of free fatty acids (FFA) and IR. Obesity, especially visceral fat, IR and physical inactivity are all strongly correlated [74]. There is a lack of longitudinal studies on the direction of causality, and at the moment it is difficult to disentangle which comes first: physical inactivity, IR or overweight.

Upper-body obesity is associated with the release of large amounts of FFA, which contribute to accumulation of lipids in muscle and the liver. In the liver, a high concentration of fatty acids are associated with overproduction of very-low-density lipoprotein cholesterol (VLDLc), which reduces the concentration of HDLc and increases the concentration of low-density lipoprotein cholesterol (LDLc), TG and glucose. In muscle, a high concentration of FFA reduces insulin sensitivity, with accompanying reductions in glucose uptake, metabolism and storage, and accumulation of TG. High concentrations of FFA also predispose to IR and compensatory hyperinsulinaemia [75]. Obesity may also lead to increased production of several cytokines (tumor necrosis factor-alpha, plasminogen activator inhibitor-1 and interleukin-6) which are associated with IR [75]. Insulin regulates blood glucose levels, has anti-lipolytic effects and stimulates lipoprotein lipase. When IR develops, more fatty acids are broken down from TG molecules, and the biological effects of insulin are inhibited. Further, with IR present, the vasodilatory effects of insulin can be lost [76]. Together with elevated levels of FFA, which can mediate vasoconstriction, these may promote development of hypertension. IR has also been shown to increase the production of inflammatory cytokines, which play a key role in the aetiology of CVD [77]. IR in skeletal muscles is a cardinal feature of T2D, and is thought to be the predominant underlying risk factor for the MetS [78].

As discussed in the next section, the health benefits of engaging in MVPA have been documented extensively, and sedentary behaviour is associated with a variety of health risks [10, 79]. Until recently, this was seen as two sides of the same coin. However, sedentary behaviour has deleterious effects on health that are distinct from the lack of MVPA [80]. Sedentary behaviour should therefore not be used as a synonym for not exercising (physical inactivity). Sedentary behaviour is defined as “muscular inactivity rather than the absence of exercise” [81]. The Australian Diabetes, Obesity and Lifestyle study observed dose-response associations between television-viewing and waist circumference, SBP, and postprandial glucose (glucose-2h), TG and HDLc levels in 4064 healthy physically active participants [82]. Observational studies have also reported that sitting time or sedentary behaviour, correlates positively with plasma insulin [83] and blood glucose levels [84] independent of the time spent in MVPA. In a prospective study, time spent in sedentary behaviour (measured with an accelerometer) at baseline was associated with fasting insulin concentration at follow-up; this association was further strengthened after adjusting for MVPA [85]. In another study, breaks in sedentary time were shown to be associated beneficially with waist circumference, TG level and glucose-2h [86]. Some have therefore suggested that sedentary behaviour is a paradigm in its own right that is distinctive to that of MVPA [81], and that the physiology of inactivity is not the opposite of the physiology of exercise [10]. Based on this difference of focus, a person might consider both reduce sedentary time *and* increase MVPA to further reduce the risk of developing lifestyle diseases. As more accelerometer studies are reported we will have the opportunity to disentangle the effect of a lack of MVPA from those of sedentary time.

The prevalence of CVD and CVD risk factors in South Asian immigrants

A few studies have investigated the health of South Asian immigrants in Norway [4-6, 87]. In the Romsås in Motion study, the age-adjusted prevalence of diabetes was 14.3% (95% CI = 8.0 to 20.7) among South Asian men and 5.9% (95% CI = 4.2 to 7.5) among Western men [4]. The combined Oslo Health Study and Oslo Immigrant Health Study found a higher prevalence of self-reported diabetes among Pakistani men (12%) compared with ethnic Norwegians (2%) [6]. Even larger differences between Pakistani men and ethnic Norwegians (14% vs. 2.6%) were reported by Syed et al. [87]. South Asian immigrants in Norway have also been shown to have higher levels of TG [6], higher prevalence of obesity [6] and the MetS (study on women only) [5], and lower levels of HDLc [6], but lower levels of total cholesterol and blood pressure (BP) [6], higher degrees of psychosocial distress [88] and a higher prevalence of poor self-rated health [87].

Poorer health among South Asian immigrants has also been found in other Western countries such as the UK, the USA, Canada, Australia, Denmark and Sweden. A higher prevalence of CVD [13, 89], CHD [89, 90], T2D [91-94] and the MetS [56, 90, 90, 95] in South Asians compared with the general population and/or other immigrant groups has been reported consistently in these countries. The excessive risk of CHD in South Asians is about 40% to 60% higher compared with the population of England and Wales [91], and the prevalence of T2D is four- to six-fold higher in South Asians [96, 97]. The Southall Diabetes Survey was one of the first population-based studies to show a high prevalence of known diabetes among South Asians compared with Europeans in the UK [98]. The study found that South Asians in the age group 30 to 64 years had a five times higher prevalence of diabetes. In an 11-year follow-up study of those who reported having diabetes in the Southall study in 1984, the South Asians (n = 730) showed a markedly increased predisposition to CVD compared with the Europeans [99]. Both mortality and morbidity from ischaemic heart disease were increased in the South Asians, with a two- to threefold excess over their European counterparts. Three of four deaths among South Asians were attributed to circulatory diseases. The higher prevalence of diabetes in South Asians compared with the majority population has been confirmed many times since the Southall Study in the 1980s in the UK [91, 100-103], and in Canada [93], the USA [56, 92] and Denmark [104]. In a review article of the prevalence of diabetes among immigrants in the Nordic countries the South Asians had a relative risk of 2.4 to 5.5 [94]. Dyslipidaemia [13, 51, 90] and hypertension [90, 96, 105] also seem to be more prevalent among South Asian immigrants. Measures of BMI levels often do not differ between the two groups [51, 90, 105] but south Asians have a greater tendency to accumulate more truncal adiposity [90] at any given BMI level [106].

The validity of the health data on South Asian immigrants has been questioned because of misclassification of ethnicity, pooling of data (not discriminating between different South Asian ethnicities), frequent inclusion of small sample sizes, questions about the accuracy of the data and the possibility of selection bias [16]. However, the reliability of the results suggests that ethnicity is an important component in the observed discrepancies in health.

Physical activity and health

PA has always been an essential aspect of human life and performance capacity, and physical skills played a major role in survival in early human history. The ability to throw a spear, run, escape and fight were essential skills for our ancestors, and lack of skills could mean premature death, which could mean missed opportunities for propagation. Advances in modern technology, such as automobiles, escalators, golf carts, computers and automation, have made it possible for humans to choose to live sedentarily. As the necessity for people to engage in challenging PA has disappeared, diseases related to a physically inactive lifestyle have become apparent. Thus, intentional PA has become an important component of a healthy lifestyle and longevity. We now have a large body of evidence showing that being regularly physically active and physically fit has significant beneficial effects on health.

The human body is designed for movement and is capable of adapting quickly to a wide range of metabolic demands imposed by PA. Known physiological adaptations to an increased PA level include increased muscle mass and a change from type IIx fibres to type IIa skeletal muscle fibres, increased number of capillaries in skeletal muscle fibres, increased number and size of mitochondria in skeletal muscle fibres, increased ability to use fat as an energy source, and increased cardiac output and pulmonary ventilation. These and many other adaptations to regular PA might be important contributors to the improved health associated with PA. For example, type IIa fibres are more insulin sensitive and have more GLUT4 receptors than IIx fibres, and the increased number of coronary arteries may increase the threshold for ischaemia. The next section describes the effects of PA on mortality, CVD and CVD risk factors, and the more disease-specific adaptations that occur as a result of PA.

Physical activity and mortality

After adjustment for confounders, MVPA and CRF is associated with reduced all-cause and CVD mortality in healthy adults [21, 107-115], and in patients with CVD [114] or T2D [116-119]. In the study by Leitzmann et al. [110], those who fulfilled the PA guidelines had a 27% decreased mortality risk (relative risk, 0.73; 95% CI = 0.68 to 0.78) compared with those who were physically inactive. An even greater mortality protection can be achieved with higher volumes of PA [120]. A review of 44 observational studies from 1966 to 2000 presented strong evidence of an inverse linear dose-response relationship between the volume of PA and all-cause mortality, although the independent effects of intensity, frequency and duration was not clear [120]. T2D participants who walked for at least 2 $h \cdot week^{-1}$ had a 39% lower mortality rate (hazard rate ratio, 0.61 (95% CI = 0.48 to 0.78) compared with inactive individuals [117]. Sandvik et al. [21] showed that a low fitness level increased the relative risk of death from any cause and of death from cardiovascular causes compared with a high fitness level in a 16 year follow-up study in 1960 healthy men aged 40 to 59 years.

Physical activity and cardiovascular diseases

It was when Morris and colleagues examined the health effects of active occupations on workers that the era of modern PA epidemiology began. In 1953, Morris's group published a study in The Lancet where they reported approximately 50% lower rates of CHD in physically active double-decker bus conductors compared with the more sedentary bus drivers [121]. After this landmark study a plethora of research has been performed on the effects of PA on CVD, especially CHD, although there are no randomized controlled trials (RCT) with CVD as a clinical outcome [12]. An influential meta-analysis by Powell et al. [122] found an inverse relationship between PA and CHD. The relative risk of CHD associated with physical inactivity varied between studies but generally ranged from 1.5 to 2.4. This association was independent of confounding factors, and physical inactivity was as a robust risk factor as smoking, SBP and total cholesterol level. Some reviews and meta-analysis have shown that being physically active reduces the risk of CHD by 30% to 50% [123-127]. The meta-analysis by Sofi et al. [126] of 26 studies incorporating 513 472 participants who were followed for 4 to 25 years showed that physically active individuals had a 27% lower risk of CHD incidence. In the Harvard Alumni Health Study the incidence rates of CHD were tracked during a 6- to 10-year follow-up [111]. Men who spent more than 2000 kcal in leisure-time PA per week (stairs climbed, city blocks walked and type of sports played were recorded and converted to EE) were at 39% less risk than classmates who expended less energy during PA.

The mechanisms underlying the protective effect of regular PA on CVD and mortality are not understood completely, but are probably multifaceted. The most important effect of PA on CVD risk is the beneficial effect on many of the CVD risk factors such as T2D, the MetS and individual MetS components [128]. However, after controlling for the traditional CVD risk factors, physical inactivity and poor CRF remain as independent factors for CVD. Increased PA and CRF levels also influence CVD risk through non-classical mechanisms; for example, PA has beneficial effects on endothelial function, which may prevent the atherosclerosis process and the development of thrombosis [122, 129]. Reduced levels of C-reactive protein associated with PA may also contribute to the prevention of the atherosclerosis process [130]. Specific adaptations to the heart in response to regular PA, such as an increased number of arteries, improved vascular compliance and hypertrophy of the ventricles, may also protect against CVD.

Physical activity and type 2 diabetes

A systematic review of 10 prospective cohort studies (follow-up periods ranging from 4.2 to 16.9 years) including a total of 301 221 participants analysed the role of MVPA and walking in people with T2D [131]. The summary relative risk of T2D was 0.69 (95% CI = 0.58 to 0.83) for regular participation in MVPA compared with being sedentary. The relative risk was 0.70 (0.58 to 0.84) for regular walking ($\geq$ 2.5 $h \cdot week^{-1}$ of brisk walking) compared with almost no walking. The strongest evidence of the beneficial role of PA in the prevention of T2D comes from RCTs conducted in China [132], Finland [133], the USA [134], India [135] and other countries [136]. These studies have shown that the risk of developing T2D can be halved in people with impaired glucose tolerance (IGT) by lifestyle changes (diet and PA) compared to those who receive usual care. In the Finnish Diabetes Study, the risk of diabetes was strongly associated with the number of lifestyle goals achieved [133]. Furthermore, participants who walked for an average of 2.5 $h \cdot week^{-1}$ were 63% to 69% less likely to develop T2D at the post-test than were those who walked for < 1 $h \cdot week^{-1}$ [137]. The Finnish researchers have stated that most of the cases of T2D can be prevented [138]. A meta-analysis showed that lifestyle interventions seem to be at least as effective as pharmacological interventions [136]. Follow-up of the Chinese and the Finnish diabetes prevention studies have shown that lifestyle interventions can prevent or delay diabetes for many years after the end of the intervention [139, 140]. Most beneficial effects of PA on T2D prevention and management are realized through the acute and long-term improvements in insulin sensitivity [141-143] and plasma glucose concentration [143-146]. A meta-analysis of 12 aerobic exercise studies and two resistance exercise studies found that when the post-intervention results were pooled, glycosylated haemoglobin (HbA_{1c}) level was reduced by an average of 0.66 percentage points (7.65% vs. 8.31%; $P < 0.01$) [147]. This is similar to the reductions achieved with drugs or insulin therapy [145]. A 1% absolute decrease in HbA_{1c} level is associated with a 15% to 20% reduction in major cardiovascular events [148].

The acute mechanisms through which PA exerts its effect on diabetes risk mainly involve increased uptake and metabolism of glucose, which is transported through the cell membrane by the glucose transporter 4 (GLUT4), which is activated by insulin and muscle contractions. Because the cells need to rebuild their glycogen stores, glucose uptake in muscle cells increases for a few days after a single bout of PA [149]. In addition insulin sensitivity is increased for up to three days after a single bout of PA [149]. Chronic effects include increased amounts of GLUT4 and glycogen synthase in the muscle cells, improved insulin sensitivity, increased ability to oxidize lipids and increased glycogen storage capacity. In addition, increased PA may prevent diabetes complications by ameliorating a state of low-level inflammation associated with IR and chronic hyperglycaemia [150].

Physical activity and the metabolic syndrome

A few RCTs have reported on the effect of PA on the MetS. Anderssen et al. [151] found a 23.5% reduction in the number of participants having the MetS in an exercise group vs. an

11.5% reduction in the control group after a one-year exercise intervention (supervised endurance exercise three times per week at an intensity of 60% to 80% of peak heart rate). In the Finnish Diabetes Prevention Study those who increased MVPA the most were more likely to show resolution of the MetS or were less likely to develop the MetS [152]. Johnson et al. [153] found that an eight-month exercise intervention of moderate intensity (walking 17 $km \cdot week^{-1}$) in sedentary, overweight middle-aged men and women significantly improved the Mets compared with controls. In an uncontrolled study by Katzmarzyk et al. [154] 30.5% of the participants were no longer classified as having the MetS following 20 weeks of aerobic exercise intervention. A protective role of PA was also found in a prospective study that assessed leisure-time PA over a period of 12 months in a population-based cohort of 612 middle-aged men in Finland. Men who engaged in > 3 $h \cdot week^{-1}$ of MVPA were half as likely to have the MetS at the four year follow-up compared with sedentary men [155]. In a longitudinal prospective study by Holme et al. [156], baseline leisure-time PA level was a significant predictor of the MetS at the follow-up 28 years later.

Beneficial associations between PA and the MetS have also been reported consistently in cross-sectional studies using either questionnaires [157-162] or accelerometers [163, 164] to measure PA. In a cross-sectional study on 1069 healthy middle-aged men, those who engaged in moderate-intensity leisure-time PA $\leq 1.0\ h \cdot week^{-1}$ were 60% more likely to have the MetS than those engaging in $\geq 3.0\ h \cdot week^{-1}$, after adjusting for confounders (age, smoking, socio-economic status (SES) and alcohol) [165]. The study also showed that men with a $VO_{2max} \leq 29.1\ mL \cdot kg^{-1}$ were almost seven times more likely to have the MetS than those with a $VO_{2max} \geq 35.5\ mL \cdot kg^{-1}$. An inverse association between CRF levels and prevalence of the MetS has been shown in several cross-sectional studies [19, 157, 166, 167], and this relationship persists after adjusting for visceral and subcutaneous fat [20]. Finally, accelerometer studies have found independent associations of both light-intensity PA and CPM with fasting insulin concentration, waist circumference and TG and HDLc concentrations [168, 169].

Physical activity and overweight/obesity

There is strong consensus that a loss of 5% to 10% of body weight confers health benefits [170]. Although overweight is a major risk factor for T2D and the MetS, and hence CVD, health benefits can also be achieved without weight reduction. Physically active or physically fit overweight people have a lower risk of CVD than do normal-weight inactive or unfit individuals [171]. However, a fit/active person who is overweight still has an increased CVD risk compared with a fit/active normal-weight person [171]. PA can prevent or reduce overweight and obesity by contributing to increased EE and thereby a negative energy balance. PA can also increase RMR by stimulating skeletal muscle growth. Although studies show that overweight and obese people are less physically active [172, 173], a review by Wilks et al. [174] reported that objectively measured PA volume is not strongly prospectively related to adipose mass.

Only a few studies using PA as the only intervention in sedentary overweight or obese participants have induced more than a 3% decrease in body weight [175, 176]. Although, in theory, high-intensity PA may be most effective for losing weight (when the PAEE is constant), most studies include low- to moderate-intensity PA because high-intensity PA is believed to cause too much strain in obese and untrained people. Perhaps not surprisingly, in a systematic review the ACSM found an association between weekly EE and the amount of weight loss [170]. This systematic review concluded that PA of < 150 min·week^{-1} results in minimal weight loss compared with controls, PA of > 150 min·week^{-1} results in modest weight loss of 2 to 3 kg, and PA between 225 and 420 min·week^{-1} results in 5 to 7.5 kg of weight loss. A statement by the International Association for the Study of obesity claims that the current guidelines for PA are likely to be insufficient for preventing weight gain or regain [177]. To prevent overweight and obesity, a minimum of 45 to 60 min of MVPA per day is recommended, and to prevent regain of weight in formerly obese people, a minimum of 60 to 90 min of MVPA per day is recommended [177].

Physical activity and lipids

A review article of the effects of ≥ 12 weeks of aerobic exercise training on blood lipid concentrations in people with normal lipid levels or dyslipidaemia included 51 interventions (n = 4700, mean age 46.6 years), 28 of which were RCTs [178]. The most consistent finding was an increase in HDLc, whereas reductions in total cholesterol, LDLc and TG concentrations were observed less frequently. HDLc concentration increased by an average of 4.6% ($P < 0.05$), and TG, LDLc and total cholesterol concentrations decreased by an average of 3.7% ($P < 0.05$), 5.0% ($P < 0.05$) and 1.0% (P = not significant), respectively. The authors concluded that there are currently insufficient data to establish a dose-response relationship between PA characteristics and blood lipid levels, but that most of the studies in the review that achieved beneficial changes in blood lipid concentrations typically prescribed moderate-intensity exercise for at least 30 min, three times per week. This is similar to the results of a meta-analysis from 2007, which included 25 RCTs and reported beneficial effects of PA on HDLc concentration in trials in which the estimated PAEE was > 900 kcal·week^{-1} (or 120 min·week^{-1}) [179]. In the 13 trials in which PAEE did not exceed 900 kcal·week^{-1} PA did not have a significant effect on HDLc concentration. The effect of PA on plasma lipid concentrations has been suggested to be caused by reductions in body fat, although several PA studies have shown favourable changes in lipids in the absence of body fat changes [180]. Increased lipoprotein lipase activity associated with PA may also have favourable effects upon blood lipid levels [181].

Physical activity and blood pressure

The results from three meta-analyses performed in the past decade have contributed to recognition that PA is a cornerstone in the prevention and management of hypertension [182-184]. The meta-analysis by Cornelissen and Fagard (2005) included 72 RCTs with 3936 participants (median age of 47 years) with a study duration of 4 to 52 weeks, median exercise frequency of three days per week, median PA intensity of 65% of maximal heart rate, and median exercise session duration of 65 min [182]. PA induced a net weighted mean change in SBP of -2.4 mmHg (95% CI = -4.2 to -0.6) and -6.9 mmHg (95% CI = -9.1 to -4.6), and DBP of -1.6 mmHg (95% CI = -2.4 to -0.7) and -4.9 mmHg (95% CI = -6.5 to -3.3) in normal and hypertensive participants, respectively. Similar results were found in the two other meta-analyses, and the effect of PA on BP was independent of any weight reduction [182-184]. A dose-response relationship has not been established.

PA decreases BP by reducing in systemic vascular resistance and through the beneficial effects on the sympathetic nervous system (lower plasma norepinephrine level) and the renin-angiotensin system [185]. The effect of PA on known risk factors for hypertension (IR, hypertriglyceridaemia and overweight) may also contribute to the reduction in BP [185].

Physical activity and health in South Asian immigrants

We have not been able to find any prospective studies that investigated the health effects of PA in South Asian men. Kousar et al. [186] found that a culturally appropriate intervention in Pakistani immigrant women in Australia that focused on PA and diet significantly increased PA levels from 4000 ± 22 steps per day to 8617 ± 596 steps per day, and significantly reduced BMI, BP, plasma levels of cholesterol and insulin, and blood glucose level. However, the study lacked a control group and did not include an analysis to test the independent effect of PA. Cross-sectional studies have found an association between PA levels and CHD mortality in South Asians immigrants in the UK [105] and smaller waist circumferences in Asian Indian immigrants in New Zealand [54]. In Asian Indian immigrants residing in North America, moderate PA was associated with a lower prevalence of the MetS, lower fasting and postprandial glucose and TG concentrations. Heavy PA was associated with reduced waist girth, and low levels of PA were associated with low HDLc concentration [187].

Poorer health in South Asian immigrants: a combination of genetics and lifestyle?

The above-mentioned studies suggest that there is a high degree of consistency in the literature in that south Asian immigrants living in Western countries have higher rates of CVD and T2D, which seem to develop a decade earlier [13] and at a lower BMI and waist circumference [56, 188] compared with Caucasians. South Asians also have higher age-standardized rates of death from CHD [103, 189] and increased mortality risk from diabetes compared with Europeans [103]. Few studies have investigated the root metabolic or genetic factors responsible for this concerning trend, and the reason for the poorer health is not known, but can probably be attributed to several factors or a combination of factors. A high prevalence of the conventional CVD risk factors such as T2D, the MetS, dyslipidaemia, hypertension, hyperglycaemia and central obesity cannot explain the higher prevalence of CVD alone [190]; i.e., they do not fully account for between-ethnic-group differences in CVD risk [103]. A study comparing coronary risk factors in South Asians living in London with their siblings in the Punjab region in India found that those who had migrated had far worse risk profiles [191]. However, the prevalence of non-communicable diseases was also high among south Asians who had not migrated [190]. Taken together, this suggests that there is a complex interaction between genes and environment (changes in PA and diet) in the pathogenesis of CVD in South Asian immigrants. Other factors such as the migration process, which may lead to stress and depression [192], time since immigration [193], low SES [102], lower likelihood of being prescribed medication [13] and poorer healthcare access and treatment [103] may also contribute.

A major theory in relation to the increased susceptibility to CVD and T2D in South Asian immigrants is a tendency to develop IR. Several studies have shown that South Asian immigrants have higher insulin levels compared with Caucasians adults [103, 190, 194-198] and children [199]. The average BMI of South Asians is not higher than that of Europeans, but South Asians have a greater tendency to deposit intra-abdominal fat, which is more strongly related to IR compared with fat stored elsewhere (e.g., thighs). As described previously, IR is a condition in which a given amount of insulin produces a subnormal biological response. In response to this defect, the body secrets more insulin into the bloodstream, leading to hyperinsulinaemia, which is associated with dyslipidaemia and endothelial dysfunction and can lead to CVD and T2D. The mechanisms responsible for the low insulin sensitivity and high prevalence of IR in South Asians are not clear, but a low PA level [53], dietary factors [199, 200] and low birth weight [201] are suggested factors.

Lifestyle interventions for increasing physical activity in South Asian immigrants

To our knowledge, there are no RCTs or quasi-experimental studies that aimed to improve the PA level in South Asian immigrant men residing in Norway or other Western countries. Some studies have investigated PA in other ethnic minority groups. In a review of 14 studies, mainly on African-Americans, the interventions included a wide range of approaches: community-oriented, family-oriented, church-based and home-based [202]. Overall, the results from the interventions were disappointing, and only two studies achieved changes in PA level. The authors concluded that it is not clear which factors are critical for efficacious interventions but that community/participant involvement and a thorough assessment of needs, attitudes, preferences and unique barriers are needed before the implementation of the intervention. Interventions that are not tailored to ethnic minorities but simply copied from successful interventions on other groups have not been successful [203]. Interventions should therefore be tailored specifically to the targeted ethnic group because ethnic minority populations might have specific barriers to and mediators of PA that differ from those of other groups. Eight years after the review paper by Taylor et al. [203] another review focusing on PA interventions targeting ethnic minorities was published. The authors concluded that there are still few high-quality data on effective and substantial improvement in PA from interventions in ethnic minorities [203].

In general, there is some evidence that a number of factors contributed to the low PA level in different ethnic groups. The barriers reported fit into common themes such as environmental barriers, perceptions of health and injury, cultural and religious issues, issues of social relationships and socio-economic challenges [204]. South Asians in the UK have reported barriers such as lack of time due to family obligations, fear and shame, weather, negative perceptions of PA and disease, lack of finances and lack of transport [53, 205]. In addition, the month of Ramadan and the requirement to pray five times a day can negatively influence PA behaviour in Muslims [204]. Language can also be a barrier to PA in that participants in activity programmes may find it difficult to follow instructions from an instructor or programme manuals [204]. In a study of South Asians in the UK, neither the low SES nor psychological distress explained the low PA level, and the authors suggested that cultural explanations may be important; for example, South Asians born in the UK were more active than those born elsewhere [52]. Although birthplace may be a crude measure of acculturation, this may indicate that less traditional South Asians adopt more active profiles [52]. However, objective measures of PA have suggested that British children of South Asian parents are less physically active than those of European white and African-Caribbean parents [206].

Social cognitive theory – behavioural modification

Developing PA interventions that have both a short-term effect and a sustained, long-term effect on PA behaviour and that are cost effective is challenging. Fewer than half of those who initiate any type of PA regimen will continue the behaviour thereafter, but with stronger effects in studies in which theory-driven behaviour modification was applied [207, 208]. When interventionists, and the incentives they provide, are no longer salient, PA tends to decline with time [208]. The health effects of PA are short lived, and long-term adherence to a physically active lifestyle is essential to establish sustainable health effects.

PA varies by age, sex, SES, ethnicity and other demographic variables [209, 210]. In addition, a wealth of modifiable determinants of PA have been found [210]. Studies are often cross-sectional, and the term “determinant” used in the literature is a misnomer because correlational studies cannot lead to conclusions about causation [210]. Although “correlates” of PA would be more correct, “determinants” is used in this thesis because it is the most commonly used term to describe factors associated with PA behaviour. There are many proposed determinants in the literature, and it is recommended to use theories as a guide for developing PA interventions [211]. Theories have generated ideas about factors that might encourage people to change their PA behaviour. Factors leading to a change in PA behaviour are called “mediators”. Beneficial changes in a mediator should lead to beneficial change in PA behaviour. Thus, we should strive to target potential mediators through our PA interventions [211]. For example, Bandura`s social cognitive theory (SCT) [212] states that increasing self-efficacy toward PA may lead to a beneficial change in PA behaviour.

SCT is acknowledged as one of the leading health behaviour change theories to explain and predict PA in the general population [213, 214] and in those with T2D [215] or cancer [216]. SCT is recommended for use in promoting PA by the US Department of Health and Human Services. SCT specifies a core set of potential mediators, the mechanism through which they work and the optimal ways of translating this knowledge into effective practices [212]. Key SCT constructs, as applied to PA, include the physical environment (i.e., opportunities to perform PA), the social environment (i.e., social support for PA from family and friends, physically active role models), self-efficacy (i.e., confidence to do PA), outcome expectancies (i.e., expected benefits and costs of performing PA), behavioural capability (i.e., knowledge and skill to perform PA) and self-control (i.e., personal goal setting and monitoring of PA). Generally, SCT posits that personal, environmental and behavioural factors are reciprocally influential in determining behaviour and behaviour change [217].

Knowledge sets the precondition for change [212]. If people are not aware of the health risks associated with physical inactivity, they have little incentive to change their behaviour. The central tenet of SCT is self-efficacy, which is defined as “the belief in one’s capabilities to organize and execute the courses of action required to produce given attainments” [218]; i.e., the person must believe in his/her ability to perform PA. Self-efficacy has been consistently and positively associated with adoption and maintenance of PA behaviour [210, 219]. Overcoming impediments is vital to success, and a high self-efficacy belief increases for example the probability that a person will attend an exercise class even when feeling tired. Possessing appropriate skills and knowledge to overcome barriers may therefore be important, because people may not proceed with any action when they do not feel they have the necessary skills [220]. A stronger self-efficacy belief produces higher goals and a stronger commitment to these goals. People with a high self-efficacy belief expect to realize more favourable outcomes as compared with those with a low self-efficacy belief. According to SCT, self-efficacy is determined by factors such as mastery experience, vicarious learning, verbal persuasion and physiological feedback [221]. One way to increase self-efficacy is by experiencing success. Thus, implementing strategies such as setting small and achievable goals may help a person to develop a sense of mastery over his/her behaviour, which would increase the likelihood for continuing the behaviour [222]. Vicarious learning may enhance self-efficacy perceptions by observing people that are similar to one-self (role-modelling) succeed and thereby gain positive reinforcement. A meta-analysis of studies of healthy adults found that interventions that included techniques such as action planning, providing instruction, facilitating social comparison, providing information on consequences of physical inactivity behaviour and time management produced significant changes in self-efficacy and PA [219]. Social support is also associated with self-efficacy [217] and PA [217]. Social support can be understood as the perceived support for PA received from others, and might occur in various ways, e.g., by giving advice and suggestions or caring about and giving constructive feedback, and may come from family, friends or others.

Another major construct of SCT is outcome expectancies, which are beliefs about the consequences of one's actions; i.e., the person must value the outcomes that he/she believes will occur when performing PA and that these positive outcomes outweigh any negative outcomes that might also be experienced. Unless people believe they can produce desired effects by their actions, they will have little incentives to act or to persevere in the face of difficulties [212]. Outcome beliefs can be shaped by experience (e.g., feeling energized after a bout of PA, which increases outcome beliefs and thereby increases motivation), by watching others succeed and by obtaining information from others [223]. Together with self-efficacy, high outcome beliefs may influence goal setting and goal pursuit.

Bandura views social support, self-efficacy and outcome expectancies as necessary for maintaining a physically active lifestyle but that also self-regulatory behaviour is essential (i.e., success in changing a behaviour depends on the ability to self-monitor, to track and to plan) [212]. People with high self-efficacy beliefs and high outcome expectancies will be more likely to implement the self-regulatory strategies essential for adopting and maintaining an active lifestyle [212, 217]. Figure 1 illustrates how the SCT constructs relate to each other [212, 217]. Little research has considered the relevance of these constructs to the PA of immigrants from South Asian countries. Most behaviour theories do not take into account cultural, social and environmental factors. By contrast, SCT presumes that the interpersonal environment is critical in influencing one`s behaviour. This may be particularly relevant for a small social group such as Pakistani immigrants in Norway.

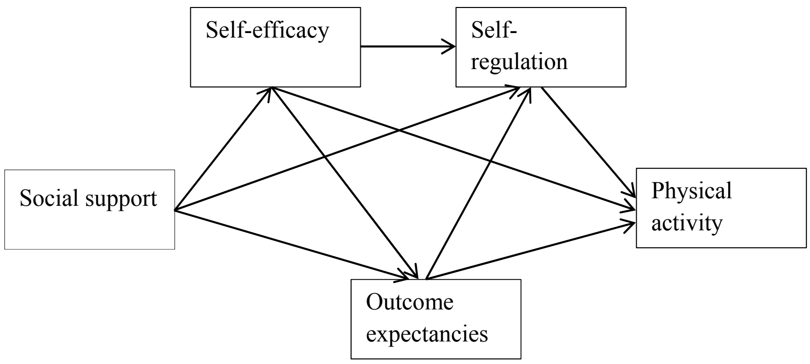

Figure 1: Social cognitive model of physical activity [217].

Need for new information

The data for the four papers are based on the results from the Physical Activity and Minority Health (PAMH) study. The underlying reason for the initiation of the PAMH study was the reported higher prevalence of CVD risk factors, including a low self-reported PA level, in Pakistani immigrant men compared with ethnic Norwegians. The white paper *National strategy to equalize social inequalities in health* (no. 20, 2006-2007) stated that the main goal is to reduce these social inequalities in health by focusing on the causes responsible for the differences in health: PA, diet and smoking. The government`s health initiatives to increase the PA level do not seem to influence the PA behaviour in the immigrant population to the same extent as in the majority population. Information on the advice and benefits of PA might not reach the immigrants or, for unknown reasons, they choose not to or are unable to follow this advice. The overarching goal of the PAMH study was to find an effective and feasible way of helping this group of immigrants to become more physically active.

Few studies on the effectiveness of PA promotion interventions have targeted or included substantial numbers of ethnic minorities to draw firm conclusions about the effects in these groups. The few studies that have focused on immigrant groups/ethnic minorities seem to have had little or no success in increasing the PA level of the participants [202]. Therefore, we have a very limited understanding of the factors and considerations that may either hinder or foster PA among South Asian immigrants [205].

To combat the disease burden among immigrants, effective theory-driven interventions that can increase the PA level and maintain this behaviour need to be developed. PA should, in theory, have the same effects on different health outcomes as those found in Caucasians, but some ethnic differences have been found. For example, there is emerging evidence that black Americans gain fewer protective effects than Caucasians for a given difference in objectively measured CRF, and pedometer studies suggest that the associations between PA and adiposity are weaker in Japanese populations than in Caucasians [224-226]. These findings suggest that there could be ethnicity-specific physiological differences in the responses to PA. However, the relationship between PA and health has not been studied thoroughly using a randomized controlled design in non-Caucasian populations, and this should be investigated further. The previous studies measuring the PA level in South Asian immigrants have used questionnaires that are not validated and CRF has not been measured; there is thus a need for objective quantification of PA and CRF levels.

Taken together, the literature provides a strong rationale for investigating the effects of a theory-driven PA programme on the PA level, *and* to evaluate prospectively the effects of PA on CVD risk factors, *and* to quantify objectively current PA and CRF levels among Pakistani immigrant men living in Oslo, Norway. This thesis strived to accomplish these goals.

Aims of the thesis

As outlined, Pakistani immigrants living in Norway represent a high-risk group for major lifestyle diseases, and increased PA seems to be a crucial preventive measure. This raises the questions of how to increase PA and to what extent increased PA might influence CVD risk factors. The general purpose of this thesis was to develop, implement and evaluate the short- and long-term effects of an SCT based PA programme on the levels of PA, CRF and other CVD risk factors in a group of Pakistani immigrant men living in Norway.

Four specific research questions were formulated:

1) What were the baseline characteristics with respect to objectively measured levels of PA, CRF and other CVD risk factors? (Paper I).
2) Did the intervention yield short-term effects on PA and CRF levels? (Paper II).
3) Did the intervention affect other CVD risk factors? (Papers II and III).
4) Did the intervention produce long-term changes in PA behaviour? (Paper IV).

Materials and methods

Project design

Participants were randomly assigned to either the intervention or control group using a computer-generated list of random numbers. The randomization ratio was 60:40, meaning that each participant had a 60% chance of being allocated to the intervention group. We chose this randomization ratio because we were afraid of a high drop-out rate in the intervention group, and we wanted a higher power to show internal relations within the intervention group. The participants were randomly allocated to one of the two groups on the day of the baseline assessments. Neither the test personnel nor the participants knew which group they had been assigned for until the testing was finished. However, the intervention allocation could not be masked from the participants and staff members involved in the intervention once the intervention started. However, the laboratory staff and data-entry personnel did not know the participants group assignments.

Participants

Men living in Oslo, Norway, with a Pakistani background (either born in Pakistan or parents born in Pakistan) who were aged 25 to 60 years and who were not physically active on a regular basis (exercising at most twice per week at a moderate or higher intensity level for 30 min or more at a time, or were active commuters (e.g., cycling or walking to work on most days of the week)) were candidates for inclusion in this study.

The recruitment process was carried out in September and October 2008. A brief oral presentation concerning the project at six mosques and at various Muslim festivals in Oslo was carried out by the main investigator. Approximately 250 men volunteered for participation in the project and of these 182 were screened. Of the 182 men, 32 failed to meet the inclusion criteria, giving 150 participants. Reasons for exclusion are provided in Figure 2. Seventeen participants were lost to the follow-up 1 (FU1) test (conducted immediately after the end of the intervention) and three more to the follow-up 2 (FU2) test (conducted six months after the intervention). A scheme of the flow of participants through the trial is presented in Figure 2.

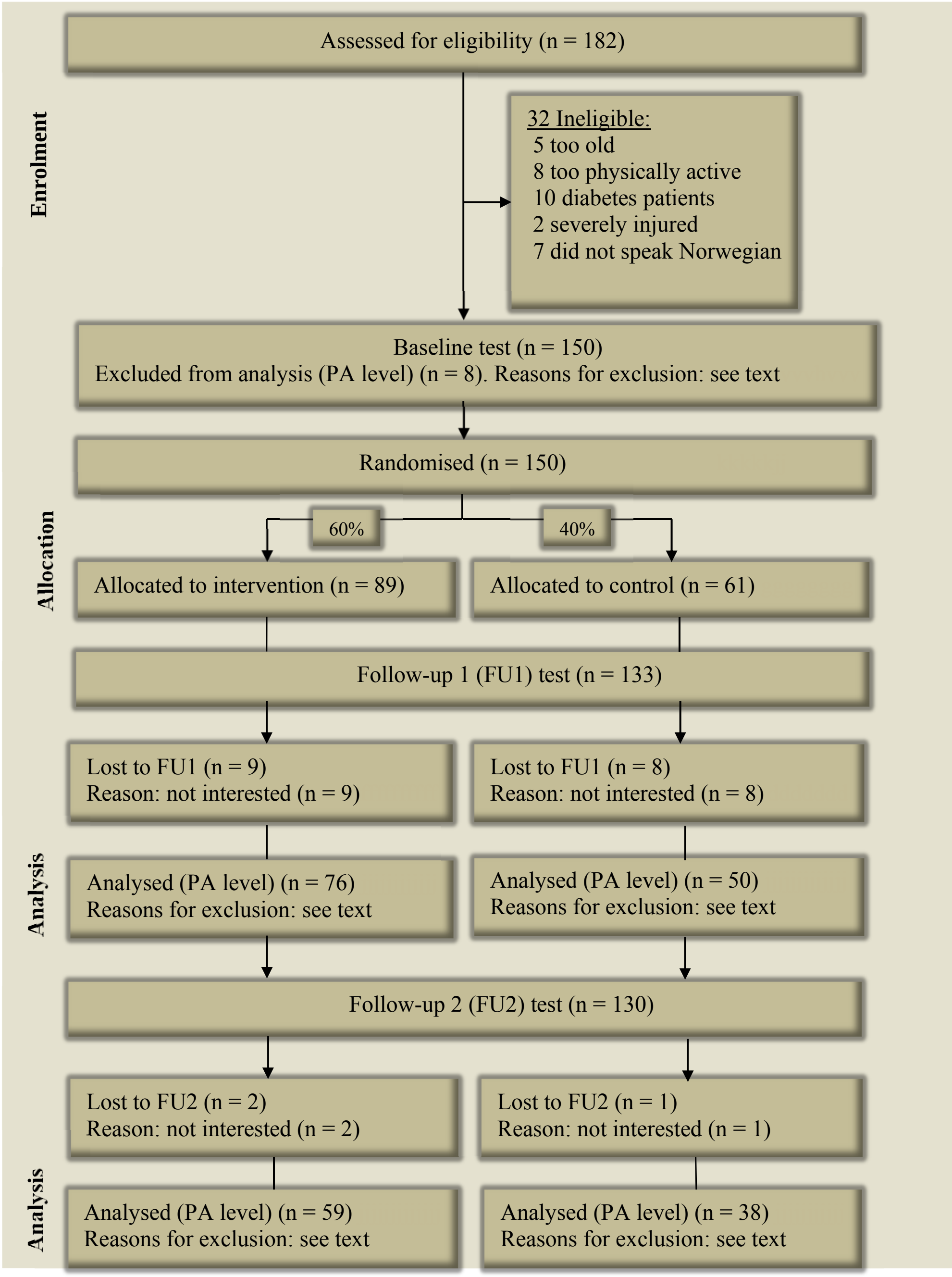

Figure 2: Flow of participants through the trial. FU1; follow up 1, FU2; follow-up 2.

Data collection

Before and immediately after (FU1) the five-month intervention participants were examined for PA habits (accelerometer), CRF, CVD risk factors and anthropometry. The participants also filled in one questionnaire assessing basic demographic information, health status, PA participation and potential psychosocial mediators for change in PA (questionnaire 1 (Q1), see appendix I) and one questionnaire on diet behaviour, developed especially for south Asian immigrants in Norway by the Faculty of medicine, University of Oslo (questionnaire 2 (Q2), see appendix II). At FU2 PA habits (accelerometer) were examined, and a shortened version of Q1 and Q2 (questionnaire 3 (Q3), see appendix III) was sent to the participants.

Baseline and FU1 intervention assessments were conducted in October and November 2008 and April and May 2009, respectively, at the Norwegian School of Sport Sciences. All tests were done in the morning and took no more than four hours. All those who attended the FU1 (n = 133) was invited to FU2, which was conducted in October through November 2009. The 130 participants who agreed to participate were sent a package by mail containing a pre-programmed accelerometer, and information on how and when to use it, a questionnaire (Q3) and a prepaid envelope for return.

Measurements

Anthropometry

Waist circumference was measured in the standing position and after a light expiration horizontally to the chest, midway between the lower rib margin and the iliac crest. Weight was measured without shoes in light clothing with a SECA electronic scale (SECA model 767, Germany) and set to the nearest 0.5 kg. Height was measured without shoes with a transportable stadiometer (Harpenden; Holtain, Crymych, GB) and set to the nearest 0.5 cm. BMI was calculated as weight divided by height squared ($kg \cdot m^{-2}$).

Physical activity

Free-living PA was assessed using ActiGraph accelerometers (ActiGraph, LLC, Pensacola, FL, USA). The activity monitor model 7164 was used at baseline and FU1, and the GT1M model at the FU2 test. The different types of ActiGraph accelerometers have been shown to produce the same results during walking and running [227]. These monitors are uniaxial (measures acceleration in the vertical plane).

The participants were instructed to wear the accelerometer for seven days on the right hip during all waking hours, except while swimming and bathing. Accelerometers were programmed to start recording at 6 am the day after the participants received their accelerometer. The epoch length (sample interval) was set to 1 min. In the analysis of accelerometer data, epoch periods with a value of zero for 60 min (with allowance for two exceptions above zero) or longer were interpreted as “accelerometer not worn” and removed from the analyses [142, 228]. PA data were included if the participant had accumulated a minimum of eight hours of activity data per day for at least two days, regardless of type of day (workday or weekends). CPM did not differ between those who wore the monitor for two days (baseline; n = 7, FU1; n = 3) and those who wore the monitor for three days or more. Subsequently, those participants who had worn the monitor for two days were also included [36]. Accelerometer data were processed and analysed using the SAS-based (version 9) (SAS Institute Inc. Cary, NC, USA) program CSA-Analyser (http://csa.svenssonsport.dk).

The minutes spent in various levels of PA intensity was calculated in which sedentary behaviour (inactive time) was defined as ≤ 100 CPM [229], light intensity PA, 101 to 1951 [142], moderate intensity PA, 1952 to 5724, vigorous intensity PA, 5725 to 9497 and any amount above 9497 was considered very vigorous intensity PA [40]. We also investigated to what extent the participants reached the recommended level of PA of at least 30 min of MVPA per day. The 30 min could be split into bouts of 10 min. A bout was defined as 10 min or more consecutive min above 1952 CPM with allowance for interruption of 1 or 2 min below threshold, to allow for small breaks in the activity (e.g., stop for red light when jogging).

One hundred and forty-two participants had valid recordings at the baseline test (95%): four lost their monitor and four had fewer than two valid days of recordings (Figure 2). At the FU1 test, 126 participants (84%) had valid recordings: 17 were lost to FU1, five had fewer than two days of recordings, and two did not return their accelerometer (Figure 2). Of the 130 participants on FU2 we had valid accelerometer recordings on 97 (65%) of the original sample: 12 participants sent the monitor back without having used it, six had fewer than two days of valid recordings and 15 did not return the monitor (Figure 2).

The participants wore the monitor for an average of 6.3 ± 1.8 days (mean ± standard deviation (SD)) at baseline, 6.1 ± 1.5 days at FU1, and 5.6 ± 1.6 days at FU2. The mean (± SD) wearing time was 13.5 ± 1.5 $h \cdot day^{-1}$ at baseline, 13.6 ± 1.6 $h \cdot day^{-1}$ at FU1, and 13.3 ± 1.9 $h \cdot day^{-1}$ at FU2.

Cardiorespiratory fitness

CRF level was assessed by measuring oxygen consumption, which was defined as the highest measured oxygen consumption (peak VO_2 in $mL \cdot kg^{-1} \cdot min^{-1}$) although most of the participants fulfilled the criteria for $VO2_{max}$. Oxygen consumption was measured during a maximum exercise test on a treadmill using a modified Balke protocol [230]. Gas exchange was sampled continuously into a mixing chamber every 30 s by having the participant breathe into a Hans Rudolph two-way breathing valve (2700 series, Hans Rudolph Inc., Kansas City, MO, USA) connected to a Jaeger Oxycon Pro gas analyser (Erich Jaeger GmbH, Hoechberg, Germany), which measured the oxygen and carbon dioxide content. The analyser was volume- and gas calibrated before each test. The test result was approved when scoring ≥16 on the Borg 6 to 20-point rating of perceived exertion scale and when the respiratory quotient was > 1.1. For safety reasons, we tested only those younger than 40 years (n = 99).

Blood sampling, treatment and analyses

After a 12-h overnight fast (minimum 8-h), between 0800 and 1030 hours, venous blood samples were drawn from an antecubital vein. Blood samples were mechanically agitated for 30 min to prevent clotting, and were then aliquoted and separated. Blood samples were centrifuged for 10 min at 2500 *g* (except for HbA1c). All samples were analysed at Dr. V. FÜRST Laboratory for clinical chemistry (Oslo, Norway) the same day.

An oral glucose tolerance test was performed, in which 75 g glucose in 200 mL of water was ingested and plasma glucose, insulin and C-peptide concentrations were determined before and two hours after ingestion of the glucose drink, i.e. postprandial. A Modular P Machine (Roche, Japan) was used for measuring glucose (photometric), insulin and C-peptide (immunoassays), HDLc (immuno-turbidometric assay), LDLc (direct enzymatic method) and TG (enzymatic assay) concentrations. HbA_{1c} was measured on an HPLC, G7 instrument (Tosah, Japan).

Assessment of insulin resistance

The degree of IR was estimated by HOMA (homeostasis model assessment) according to the method described by Matthews et al. [231]. IR score (HOMA-IR) was computed with the formula: (*fasting plasma glucose x fasting serum insulin)/22.5.* Low HOMA-IR values indicate high insulin sensitivity, whereas high HOMA-IR values indicate low insulin sensitivity (insulin resistance).

Bonora et al. [232] evaluated the reliability of HOMA by comparison with the euglycemic-hyperinsulinemic clamp and found that HOMA was able to explain 65% of insulin sensitivity measured by glucose clamp, and that a misclassification of participants according to insulin resistance virtually never occurred. They further concluded that this holds true in both non-diabetic and T2D participants.

Diabetes and the metabolic syndrome

Diabetes, impaired fasting glucose and impaired glucose tolerance were defined according to the criteria set by the American Heart Association [233]. The MetS was defined according to the criteria set by the IDF [72]. By this definition, a person can have a maximum of five MetS components. If a MetS component was present, it was given the value 1 and 0 if not present. For example, a value of 3 would indicate three MetS-factors.

Blood pressure

BP was measured automatically using an Omega non-invasive BP monitor (Invivo Research, Inc., Orlando, FL., USA) in the morning after the participant had rested for 10 min in a quiet room. Three consecutive BP measurements were performed with 1 min rest between each measurement. BP was recorded as the average value of the three recordings.

Questionnaire data

The questionnaires were available in both Norwegian and Urdu. If a question was perceived as being unclear the participants had the possibility to ask the test staff for help. The questions covered a broad range of themes, including demographic information, health status, diet, PA participation and potential psychosocial mediators for change in PA. A closer description of some of the central questions is given below.

Psychosocial mediators

The following potential psychosocial mediators for change in PA from the SCT were measured: social support for PA, self-efficacy and outcome expectancies. We also measured attitude, behavioural control, and identity at baseline. The measurement properties of these scales are summarised in Table 1. All scales were derived or modified from previously developed and validated scales (Table 1), and additional exploratory factor analyses (principal components analysis with varimax rotation) were performed. A two-factor solution was found for the attitude scale, representing evaluative (5 items) and affective (3 items) aspects of attitude. These two factors accounted for 74.0% of the total variance. The mean score of all items was computed for each scale/subscale for participants with a response rate of 75% or greater on the respective item [234]. Generally, internal consistency (Cronbach's alpha) properties were satisfactory (Table 1). Information about barriers to PA was collected by asking the participants to; "Rate how relevant the listed barriers are for you". The scale went from 0 (not a barrier) to 5 (very relevant).

Table 1: Summary of psychosocial variable measurements.

Variable	Number of items / response format	Example of sample items	Original reference source on which items were based	Cronbach`s alpha Baseline, FU1 and FU2 (range)
Social support		Have your family/friends…	[235]	
- family	6 / 1 (never) - 5 (very often)	… Encouraged you to be physically active?		0.85-0.87
- friends	6 / 1 (never) - 5 (very often)			0.87-0.88
Self-efficacy	7 / 1 (not at all confident) - 7 (very confident)	I am confident I can participate in planned PA when… …I am tired	[236]	0.87-0.89
Outcome expectancies	6 / 1 (unlikely) – 7 (very likely)	If I am regularly physically active in the next month… … I will get in better shape		0.85-0.89
Attitude		Being regularly physically active the next month will to me be …	[237, 238]	
- Evaluative	5 / 1-7	… useless-useful		0.90
- Affective	3 / 1-7	… unpleasant-pleasant.		0.79
Behavioural control	3 / 1 (agree) – 7 (disagree)	Rate to what degree you agree/disagree… … I have full control over being regularly physically active	[238]	0.62
Identity	3 / 1 (suits badly) – 5 (suits well)	To what degree do these statements describe you as a person… … I view myself as a person who is concerned about PA	[239]	0.74

Diet

Information about the intake of fruits, vegetables, fish and colas was obtained using the question: “How often have you eaten or consumed…?” Participants were asked to indicate the levels on a six-point scale, ranging from “not eaten/consumed” to “daily””, for fish and colas. For fruits and vegetables the scale also included daily frequencies with the alternatives 1, 2 and 3 times·day^{-1}. In the analyses the categories “not been eaten/consumed” and “<1 time·week^{-1}” were consorted into one, also the categories “3-4 times·week^{-1}” and “5-6 times·week^{-1}” were consorted. A crude estimate of sugar intake was calculated as the sum of intake frequencies per week of sodas, juice, white bread, rice, pasta, jam, chocolate and snacks.

The intervention

Formative research

To better understand how to positively influence PA behaviour in Pakistani immigrant men we conducted two focus groups, with representatives from the male Pakistani immigrant group (n = 10 in each group, age ranged from 25 to 60 years). Each focus group meeting lasted approximately two hours. The aim of these group meetings was to explore self-efficacy levels, expectations, expectancies, preferences, and barriers to PA. These discussions indicated that the men had very few physically active friends or family members, had little knowledge about non vigorous PA, the link between PA and health and staying regularly physically active, and identified many barriers to PA (e.g., managing time) and did not know if they were able to overcome them, and they did not see many benefits of being regularly physically active. Using these results and numerous studies showing successful changes to the PA behaviour by the use of SCT constructs [240], we decided to target three primary SCT concepts to promote PA change: self-efficacy (i.e., confidence to perform PA), outcome expectancies (i.e., expected benefits and costs of performing PA) and the social environment (i.e., social support for PA from family and friends, physically active role models). The secondary SCT components included the physical environment (opportunities to perform PA) and behavioural capability (knowledge and skill). In close collaboration with representatives from the target group, we developed an intervention to target the SCT constructs.

Intervention structure

The SCT based intervention included the following components: structured group exercise sessions twice a week led by an exercise physiologist, two group lectures, one individual counselling session, written material and a phone call (Figure 3). Table 2 provides an overview of how these strategies were linked to SCT constructs. The intervention programme lasted five months. The control group received their baseline results about two weeks after the testing, and was offered organised exercise, one group lecture and written material after the end of the intervention period.

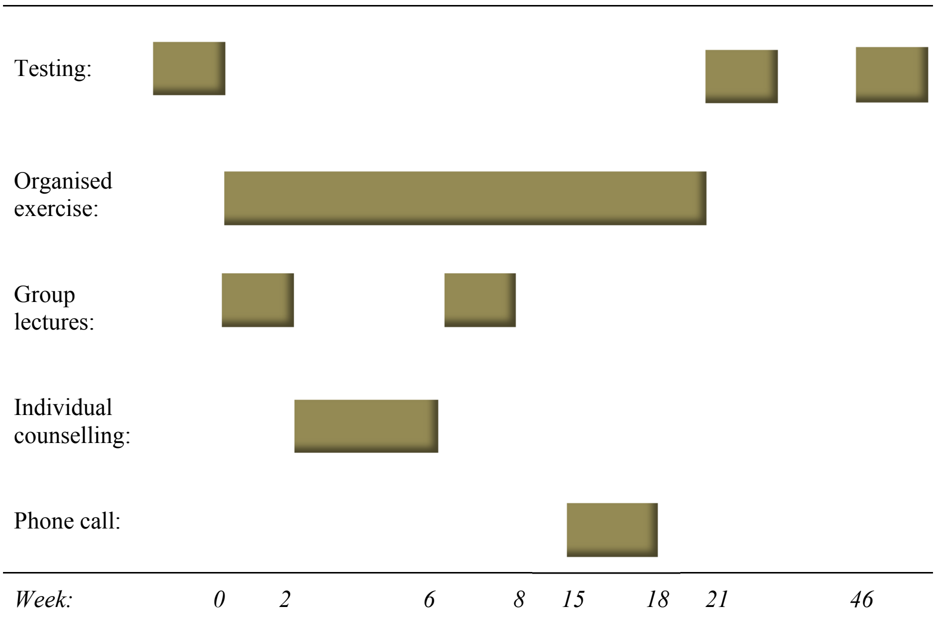

Figure 3: Overview of the intervention and the timing of the different intervention components. Note: the timeline is not linear.

Table 2: Overview of the intervention components, attendance rates, behaviour change strategies and targeted social cognitive constructs.

Intervention component	Dose	Description	Behaviour change strategy	Targeted construct
Structured group exercise	60min twice a week	Participants could choose to attend one out of five different exercise facilities in Oslo. The different exercise groups were led by an exercise physiologist. The exercise training programme was designed as a low threshold activity. The sessions had the following structure: a 15 min warm-up with easy and fun games, 40 min of floorball and/or football plus some strength exercises and a 5 min cool down. Seven participants did not attend any of the sessions (one trained by himself and six were not motivated) and two were injured at the first exercise session. The mean attendance was 60% (range: 11% to 100%).	-Provide opportunities for PA -Increase social support for PA -Promote mastery learning through skill training -Improve knowledge and skill to perform PA -Promote positive outcomes of PA -Provide credible role models for PA	-Environment -Expectancies -Self-efficacy
Group lectures	2x2h	The lectures were conducted at the Norwegian School of Sports Sciences. The project leader led the classes. Major topics were: -What is PA? -PA and health link; short- and long term effects -The harms of physical inactivity -PA recommendations and how to achieve these -Activity examples -Setting small goals -Identifying and reducing perceived barriers -Making a PA plan -Seeking social support -Self reward Both attendees and non-attendees received written summaries of the lecturers.	-Improve knowledge of PA options, including non-vigorous PA -Improve knowledge on how to incorporate PA into the daily routine -Enhance PA expectancies -Improve goal setting for PA -Improve problem solving of PA barriers -Improve social support for PA	-Social support -Expectancies -Self-efficacy
Individual counselling sessions	1h	The counselling was based on the concept that all advice must match the participants' experience of PA and degree of motivation. Together with the participant, the primary goal was to find activities that could be implemented in a usual week, with the sum of these activities enabling them to reach the PA recommendations. After discussing activity options, the participants set the goals they wanted to achieve over the five-month period. Finally, we discussed barriers by asking "What do you think can stop you from carrying out this activity plan?", and the possible barriers, and solutions to them were discussed and written down. All participants completed this part of the intervention.	-Identify opportunities for PA -Improve knowledge and skill to perform PA -Enhance goal setting for PA -Promote mastery for PA -Identify and problem solve barriers to PA	-Social support -Self-efficacy -Expectancies
Phone call	5-15min	T Three to five weeks before the first follow-up test, intervention participants in the intervention group were telephoned to discuss the activity plan, to make changes if necessary, and to encourage further efforts. All participants were reached within three attempts.	-Provide feedback on PA behaviour -Reinforce problem solving for PA -Provide encouragement and help	-Social support -Self-efficacy

Adverse effects

To see if the intervention caused any adverse effects, injuries in the intervention period were recorded. Throughout the period there were two serious injuries (a broken leg and a disk herniation) in addition to some minor back problems. The injuries are not believed to be caused by the exercise programme per se.

Ethics

The Regional Committee for Medical Research Ethics (see appendix IV) and the Norwegian Social Science Data Services (see appendix V) both approved the study. The Norwegian Directorate of Health approved the establishment of a biobank (see appendix VI). Before participation in the study, written informed consent was obtained from each participant (see appendix VII). All participants were informed of their right to withdraw from the project at any time, including their test results.

Sample size calculation

In the sample size calculation, we used CPM from the accelerometer recordings as the primary outcome variable. A difference in group means of 60 CPM (i.e., 15% to 20% increase) was considered as an important change. Based on data from a PA intervention conducted on obese children (data not published), a standard deviation of 120 was chosen. With a power of 0.8, a significance level of 0.05 and a presumed drop-out rate of 20%, a total of 144 participants were needed.

Statistical analyses

All statistical analyses were performed using SPSS (Statistical Package for the Social Sciences for Windows, version 15, IBM Inc. Chicago, USA). Variables were tested for normality of distribution before analyses. Significance level was set at $P < 0.05$. Except for correlation and regression analysis results are presented as mean ± SD, mean ± SEM, mean (95% CI) or per cent. Effect sizes were calculated as: (changes in the control group ÷ changes in the intervention group)/SD in the control group. Statistics used at the three time points (baseline, FU1 and FU2) are described below.

Baseline (Paper I)

Independent samples t test was used for testing differences between groups at baseline. When assessing the risk of having the MetS, we used logistic regression with MetS as the dependent variable and occupation as the independent variable under investigation, adjusted for age and education level.

Follow-up 1 (Papers II and III)

The short-term response to the intervention was measured as the difference between the corresponding final and baseline values for all variables (FU1-baseline; per protocol analysis without imputations). Repeated measures ANCOVA were used for analyzing mean changes between and within groups, all analyses were adjusted for age and baseline differences. When assessing the risk of having the MetS, we used logistic regression with MetS as the dependent variable and occupation as the independent variable under investigation, adjusted for age and education level. The associations between each exposure (i.e., changes in CPM and inactive time) and changes in the outcome (insulin-2h) were examined in univariate analyses using linear regression analyses. Multivariate regression analyses were used to adjust for waist circumference when looking at the relationship among changes in CPM, inactive time and changes in insulin-2h.

Follow-up 2 (Paper IV)

The long-term response to the intervention were analysed on a per protocol basis, without imputations. Delta PA scores and the potential psychosocial mediators were calculated (baseline to FU2) and used as the dependent variable in the analysis of covariance (ANCOVA), and with baseline measurements and age as covariates when calculating the significance of differences between the groups. Independent and paired sample t tests were used to test differences between and within groups at the baseline, respectively, and t tests were used for the drop-out analysis.

According to Baron and Kenny (1986), several steps are required to demonstrate a mediation effect [241]. The criterion for a change in the hypothesized mediator to be associated with the change in PA was not met in the current study, and thus further analysis was not undertaken.

Summary of results

In this section the research questions forwarded in “aims of the thesis” will be answered. The reader is referred to the papers at the end of this thesis for more details on the results.

Drop-out analyses

Seventeen (11%) participants were lost to the FU1 test, nine in the intervention group and eight in the control group. Except for a lower baseline PA level (CPM), the drop-outs did not differ on any variable from those who completed the programme and testing. Three more participants were lost to the FU2 test however, 19 in the intervention group and 14 in the control group did not have valid accelerometer recordings at FU2. At baseline the completers (those with valid accelerometer recordings on FU2: n = 97) had a lower postprandial glucose level (mean difference = - 1.2: 95 % CI = - 0.04 to - 2.4; P = 0.04) and fasting insulin level (mean difference = - 22: 95 % CI = – 1.0 to -43; P = 0.04) and higher CPM (mean difference = 49: 95 % CI = 6.9 to 91; P = 0.02), compared to the non-completers (those with invalid accelerometer recordings at FU2 or drop-outs: n = 53). No differences were seen on other PA characteristics or on other diabetes and CVD risk factors between the completers and the non-completers at baseline. There were no differences between the completers and the non-completers on any of the PA variables, anthropometric or blood variables at FU1.

Baseline characteristics of the participants (Paper I)

Background information

Mean age of the participants was 37.3 (SD ± 7.7). Of the 150 participants included, 124 (83%) were not born in Norway (first generation immigrants). On average, the first generation immigrants had lived in Norway for 20 years (range 1 to 38 years). One hundred and forty three were employed (95%), and of these 48% were taxi drivers and 32% were white collar workers. Fifty four per cent had college education and 15% had no education or had only primary school. Fifty two per cent perceived their health to be good or very good, 36% as neither good nor bad and 11% as bad or very bad.

Physical activity and cardiorespiratory fitness

Total PA level (CPM) ranged from 86 to 847 (Table 3). There were no differences in PA between workdays and weekends. Although the mean MVPA per day was 32.3 min only six participants (4.2%) reached the PA recommendations. The participants spent 63% (8.6 ± 1.6 hours) of the waking day sedentary (CPM zero to 100) (range 36% to 80%). Eighty per cent perceived themselves as physically inactive in their leisure time. There were no differences in any of the PA variables between the first and second generation immigrants. Peak oxygen uptake ranged from 23.4 $mL \cdot kg^{-1} \cdot min^{-1}$ to 49.1 $mL \cdot kg^{-1} \cdot min^{-1}$. Twenty participants had a peak oxygen uptake less than 30 $mL \cdot kg^{-1} \cdot min^{-1}$ and 15 had an oxygen uptake above 40 $mL \cdot kg^{-1} \cdot min^{-1}$.

Table 3: Physical activity and physical fitness data.

Physical activity and fitness variables	Mean (SD)
Total PA (CPM)	308 (131)
Total PA workdays (CPM)	312 (138)
Total PA weekends (CPM)	293 (148)
Inactive time ($hours \cdot day^{-1}$)	8.6 (1.6)
MVPA ($min \cdot day^{-1}$)	32.3 (20.8)
Moderate intensity	30.4 (18.9)
Vigorous intensity	1.8 (3.6)
Peak oxygen uptake ($mL \cdot kg^{-1} \cdot min^{-1}$)*	34.2 (5.6)

Values are mean ± SD; standard deviation. *n=99, PA; physical activity, MVPA; moderate and vigorous intensity physical activity, CPM; counts per min per day.

The most common reported physical activities engaged in the past six months were; walking (39%), jogging (17%), biking (16%), ball playing (13%) and playing cricket (12%). The most frequent listed reasons for being physically active were “getting into better shape” (82%), “not gaining weight" (73%) and "prevent disease" (60%). "Lack of time" was the most prevalent reported barrier towards being physically active, with 92% reporting this as a relevant barrier. Other common barriers were; "lack of motivation" (86%), "poor physical fitness" (80%), "bad weather" (75%) and "do not know how to perform PA" (65%).

Cardiovascular disease risk factors

Thirty five participants were current smokers (23%). Ninety three per cent and 81% were classified as overweight according to BMI ≥ 23 $kg \cdot m^{-2}$ [188] and waist circumference ≥ 90 cm [72], respectively. Ninety five participants (64%) had a family member with diabetes and many had disturbances in their carbohydrate metabolism (Table 4). Mean fasting (5.3 ± 0.9 $mmol \cdot L^{-1}$) and postprandial (6.9 ± 2.9 $mmol \cdot L^{-1}$) glucose levels were within the normal range, but insulin-2h levels (796 ± 587 $pmol \cdot L^{-1}$) and the prevalence of IR were high (HOMA-IR > 2.5 [232]) (Table 4). Overall, the most frequent contributing component to the MetS other than large waist circumference were low HDLc concentration (n = 79), high DBP and/or high SBP (n = 78) and high concentrations of TG (n = 69) and glucose (n = 40).

Table 4: Carbohydrate metabolism and metabolic syndrome.

	Cut off values ($mmol \cdot L^{-1}$)			n (%)
	Fasting		2-h OGTT	
Normal[1]	< 6.1		< 7.8	106 (70)
IFG[1]	6.1 to 6.9		< 7.8	2 (1.3)
IGT[1]	< 7.0		≥ 7.8 and < 11.1	27 (18)
Diabetes[1]	≥ 7.0	or	≥ 11.1	11 (7.3)
MetS[2]				75 (50)
HOMA-IR				4.1 (2.4)†

[1][233], [2][72]. n=146 for Carbohydrate metabolism data, n=149 for MetS data, † mean±standard deviation, OGTT; oral glucose tolerance test, IFG; impaired fasting glucose, IGT; impaired glucose tolerance, MetS; metabolic syndrome, HOMA-IR; homeostasis model assessment – insulin resistance.

Psychosocial variables

The mean scores for identity, self-efficacy, social support from family and social support from friends all fell on the centre of the scale. That is, the participants only modestly identified themselves as physically active individuals, only modestly believed in their ability to perform PA when faced with barriers, and received modestly with support from people close to them for being physically active. Further, participants reported strong positive attitudes towards PA and high outcome expectancies.

Group differences

Despite the randomised design, there were small, but statistical significant differences between the intervention group and the control group. The intervention group was younger, had lower glucose-2h values and higher CPM. However, CPM did not differ between the groups when adjusted for age.

Short-term effects of the intervention (Papers II and III)

The main findings were the increased PA and CRF levels, and the reduction in waist circumference and insulin-2h in the intervention group compared with the control group.

Physical activity and cardiorespiratory fitness

Total PA level increased by 49 CPM (95% CI = 9 to 83; P = 0.02) compared with the control group, which translates into a 15% (95% CI = 8.7 to 21.2) higher increase in CPM. Moreover, the participants in the intervention group increased time in MVPA by 6.4 min more per day (95% CI = 0.5 to 12; P = 0.04), than the control group. Both groups decreased their time spent sedentary, and there were no significant differences between the two groups. The intervention group increased peak VO_2 by 3.6 $mL \cdot kg^{-1} \cdot min^{-1}$ (95% CI = 1.8 to 5.4; $P < 0.01$) compared with the control group.

Cardiovascular disease risk factors

In the intervention group insulin-2h values decreased by 27% more (95% CI = 18.9 to 35.0: P = 0.04) than the control group. Similar findings were found for C-peptide-2h, in which the reduction was 14% (95% CI = 7.7 to 20.2: P = 0.04) more in the intervention group. In addition, we found significant differences between the two groups in respect to changes in weight (-1.9 kg, 95% CI = -2.7 to -1.0: P < 0.01), BMI (-0.8 $kg \cdot m^{-2}$, 95% CI = -1.1 to -0.5: P < 0.01) and waist circumference (-3.4 cm, 95% CI = -4.7 to -2.0: P < 0.01). No differences were found for glucose, lipids or BP. The prevalence of the MetS and resolution of the MetS did not differ between the intervention and control groups after the five months PA programme.

Secondary analyses

To investigate associations between PA variables and important health outcomes, data from the two groups were combined to increase power. In univariate analyses reductions in insulin-2h level were strongly related to changes in both total PA (CPM) and inactive time ($min \cdot day^{-1}$) (Table 5). The B-coefficients indicated reductions in insulin of 1.5 ($pmol \cdot L^{-1}$) for every increase in CPM and a reduction in insulin of 1.6 ($pmol \cdot L^{-1}$) for every $min \cdot day^{-1}$ reduction in inactive time, and only minor changes were seen when adjusting for changes in waist circumference (Table 5). There was no evidence of any association between changes in insulin-2h with changes in either waist circumference, min in MVPA or peak VO_2.

Table 5: Relations between changes in insulin-2h and changes in PA variables and waist circumference.

Independent variables	β coefficient (±95% CI)	t-value	R^2	P value
Univariate analyses (n = 102)				
Change total PA (CPM)	-1.5 (-2.4 to -0.5)	-3.2	0.091	0.002
Change inactive time (min·day^{-1})	1.6 (0.7 to 2.5)	3.6	0.11	<0.001
Change MVPA (min·day^{-1})	-4.5 (-10 to 1.7)	-1.4	0.01	0.1
Change peak VO_2 (mL·kg^{-1}·min^{-1})	-10 (-40 to 18)	-0.7	0.009	0.4
Change waist circumference (cm)	16 (-5.4 to 38.0)	1.4	0.019	0.14
Multivariate analyses* (n = 102)				
Change total PA (CPM)	-1.4 (-2.4 to -0.4)	-3.0	0.10	0.003
Change inactive time (min·day^{-1})	1.6 (0.72 to 2.5)	3.7	0.13	<0.001

*Adjusted for changes in waist circumference (cm). CI; confidence interval, PA; physical activity, CPM; counts per min, MVPA; moderate and vigorous intensity physical activity.

Correlation analysis of the relationships between the PA variables, peak VO_2 and the MetS components in the total sample showed significant correlations only between changes in waist circumference and changes in CPM (r = -0.21, P = 0.02), MVPA (r = -0.30, P = 0.001) and peak VO_2 (r = -0.29, P = 0.01).

Long-term effects of the intervention (Paper IV)

The differences in CPM and MVPA between groups at FU1 was sustained, and even increased at six-month follow-up (FU2). Support from family and outcome expectancies increased more from baseline to FU2 in the intervention group compared with the control group. Changes in the potential social cognitive mediators were not correlated with the change in PA.

Physical activity

Table 6 displays PA data at all the three measurement times for the intervention and control groups. The delta differences (baseline to FU2) in all PA variables differed significantly between groups. CPM on both weekends and workdays changed more in the intervention group than in the control group. The intervention group had 84 more minutes of MVPA and 7.7 fewer hours of inactive time per week than the control group.

The intervention group increased the total PA level from baseline to FU2 by a mean of 36 CPM (95% CI = 4 to 70; P = 0.02), an increase of 10% (95% CI = 2 to 17) and time spent in MVPA by an average of 7.3 min·day^{-1} (95% CI = 0.8 to 13.7; P = 0.03), an increase of 21% (95% CI = 10 to 31). The intervention group reduced inactive time by a mean of 0.7 hours·day^{-1} (95% CI = -0.3 to -1.1; P = 0.001), corresponding to a reduction of 9% (95% CI = 1.5 to 16). The PA variables did not change in the control group.

In the intervention group, the only significant change in PA characteristics from FU1 to FU2 was inactive time, which was lower at the FU2 test (mean difference -0.5, 95% CI = -0.04 to -0.9; P = 0.03). In the control group, CPM (mean difference -38, 95% CI = -64 to -11; P = 0.006) and light intensity (mean difference -0.5, 95% CI = -0.9 to -0.1; P = 0.01) decreased from FU1 to FU2.

Table 6: Mean and standard deviation of physical activity data at all the three measurement times.

	Intervention group			Control group					
	Baseline	FU1	FU2	Baseline	FU1	FU2	Adjusted Δ diff (95% CI)*	Effect size	P-value
Total PA level (CPM)	328 (138)	407 (149)	389 (137)	281 (118)	317 (129)	260 (99)	81 (36 to 126)	0.64	0.001
PA level on weekends (CPM)†	304 (150)	422 (188)	370 (150)	278 (142)	319 (147)	249 (136)	124 (44 to 203)	0.47	0.003
PA level on weekdays (CPM)	332 (143)	407 (157)	388 (148)	283 (128)	320 (144)	265 (98)	72 (23 to 120)	0.48	0.004
Sedentary time ($hours \cdot day^{-1}$)	8.4 (1.6)	7.9 (1.8)	7.7 (1.5)	8.9 (1.5)	8.9 (1.5)	9.3 (1.4)	-1.1 (-1.8 to -0.5)	-0.23	0.001
Light intensity PA ($hours \cdot day^{-1}$)	4.5 (1.4)	5.0 (1.2)	5.0 (1.2)	4.0 (1.0)	4.0 (1.1)	3.6 (1.0)	1.1 (0.6 to 1.6)	0.64	<0.001
MVPA ($min \cdot day^{-1}$)	35 (21)	46 (23)	44 (23)	28 (19)	33 (21)	27 (17)	12 (4.4 to 21.1)	0.72	0.003

* Difference (baseline to FU2), all variables were adjusted for their respective baseline value and age. ANCOVA was used to analyse the data. FU1: follow-up 1 (conducted immediately after the intervention), FU2: follow-up 2 (conducted six months after the intervention). † N = 41 and 30 at the FU2 for the intervention and the control groups, respectively. PA: physical activity, CPM: counts per min, MVPA: moderate and vigorous physical activity, CI: confidence interval.

Psychosocial variables

Support from family and outcome expectancies increased more from baseline to FU2 in the intervention group compared to control group. Looking at changes within the intervention group, we found that the participants scored higher at FU2 on social support from family (mean difference = 0.3, 95% CI = 0.07 to 0.45; P = 0.008) and outcome expectancies (mean difference = 0.3, 95% CI = 0.08 to 0.6; P = 0.01). Self-efficacy and social support from friends did not change. The intervention group perceived six of the 15 listed PA barriers to be less of an obstacle than did the control group.

Changes in the SCT constructs from baseline to FU1 did not correlate with changes in PA (CPM) from baseline to FU2 (data not shown). Therefore, mediation analysis could not be performed [241].

General discussion

This thesis presents results from a randomized controlled PA trial involving 150 Pakistani immigrant men living in Norway. The first section integrates and discusses the results of the four papers within the context of the four research questions mentioned above in the Aims of the thesis. The second part discusses some methodological issues.

Discussion of results

The cross-sectional data suggest that the Pakistani immigrant men had a low PA level, low CRF level and high CVD risk. The PA intervention increased CPM, MVPA and peak VO_2, and reduced waist circumference, BMI and postprandial serum insulin concentration. It is conceivable that an increase in the amount of PA was responsible for the beneficial change in insulin concentration. Presumably, these changes imply a reduced risk of developing CVD and T2D.

Research question 1

What were the baseline characteristics with respect to objectively measured levels of PA, CRF and other CVD risk factors? (Paper I).

We found a low level of PA and CRF and a high prevalence of overweight, the MetS and IR. Especially the taxi drivers seem to be a group with high diseases risk. The present study confirms the importance of screening for T2D and preventive measures at an early age in this group.

Physical activity and CRF levels

The average PA level in the PAMH study was lower than that reported in a nationally representative study of Norwegian adults [242]. Whereas the PAMH study found an average of 308 CPM, the national study of Hansen et al. reported a value of 342 CPM in Norwegian adult men. The PA level in the national study was higher in all age groups except for those aged 70 years and older. Whereas only 4% of the men in the PAMH study fulfilled the PA recommendations, 19% of the ethnic Norwegians did. Two other nationally representative studies using accelerometer to assess PA level, one from Sweden [243] and one from the USA [228], have been published. The mean CPM were 375 (95% CI = 360 to 390) in the Swedish adult population and 377 (95% CI = 363 to 391) among the Americans. Compared to these two studies the PAMH participants had PA levels similar to those of the elderly population (60-75-year age category). The time spent sedentary was slightly higher in the PAMH participants than in all age groups in the Swedish and American studies. To our knowledge, objectively measured PA data on South Asian immigrants have not been collected. However, studies using questionnaire data have consistently reported a low PA level among immigrants from South Asia in both Norway [4, 6, 244] and the UK [30, 53], confirming our results. The high incidence and prevalence of T2D and CVD among this immigrant group may be explained partly by the low level of PA, high level of physical inactivity and low CRF level observed in the PAMH study.

The reasons for the observed low PA level among the participants in the PAMH study are not understood completely. A contributing factor may be that many of the participants in our sample had sedentary jobs and long working hours. This may also explain the high percentage of the sample reporting a lack of time as a barrier to being physically active. In addition, exercise or performance of recreational activities (e.g., going for walks) may not be as common as among ethnic Norwegians. While only 39% of our participants walked regularly, 75% of ethnic Norwegian men do so [245]. It might be that cultural attitudes and values held by South Asian immigrants do not encourage participation in PA, although our results indicate that the participants held strong positive attitudes toward PA. Identifying oneself as a physically active individual, believing in one`s ability to perform PA, and receiving support for being physically active have been found repeatedly in a number of cultural settings to correlate with or to mediate PA participation [246-248]. The modest scores on these variables in the present sample may partly explain the low level of PA.

Perhaps because direct measurement of CRF is time consuming and labour demanding, and requires expensive equipment, there are no reports on CRF levels in South Asian populations. The Pakistani men in the PAMH study had similar peak VO_2 levels as Norwegian men aged ≥ 70 years in a study of men aged 20 to 90 years living in Nord-Trøndelag County (n = 2368) [23]. Furthermore VO_{2max} was higher among healthy Canadian men in all age groups except for those aged ≥ 60 years compared with our sample [25]. To establish relative VO_{2max} norms in males aged 6 to 75 years, Shvartz and Reibold [24] performed an extensive literature review of studies in which the VO_{2max} was measured directly in healthy, untrained participants in the USA, Canada and seven European countries. The sample means were used to create VO_{2max} norms for all age groups. According to these data, PAMH participants would fall into the fitness category of "poor" (fitness category 6, where 1 is excellent and 7 is very poor). Lakka et al. [165] found that participants having a VO_{2max} < 35 $mL \cdot kg^{-1} \cdot min^{-1}$ were more likely to have the MetS than those with a VO_{2max} > 35 $mL \cdot kg^{-1} \cdot min^{-1}$. This is consistent with our findings of a significantly lower peak VO_2 in those with the MetS than in those without the syndrome.

Overweight

A high degree of overweight and obesity, as measured by BMI and waist circumference, was found. The average BMI in the PAMH study is similar to that reported by Kumar et al. [6] for a sample of Pakistani men in Oslo in 2002 but is lower than that of Pakistani women (BMI = 29.3 $kg \cdot m^{-2}$). However, both the men and the women in the previous study were older (mean age 44.3 and 42.2 years, respectively) than the men in our sample. In other immigrant groups in Norway, including Turks, Iranians, Sri Lankans, and Vietnamese, only those with a Turkish background had a higher BMI than those in the PAMH sample. Much lower BMI (23.5 $kg \cdot m^{-2}$) and waist circumference (89 cm) were found in Pakistani middle-aged men living in Kharian, Pakistan [249], the same area that most of the participants in the PAMH study originally came from. This suggests that the high prevalence of obesity in our sample reflects changes in lifestyle (i.e., PA and diet [250]).

A WHO expert consultation concluded that Asians generally have a higher percentage of body fat than white people of the same age and BMI, and that the risk factors for disease are high even when BMI is < 25 $kg \cdot m^{-2}$ [188]. The BMI cut-off for overweight in South Asians is therefore lower than in whites (BMI 23 $kg \cdot m^{-2}$ vs. 25 $kg \cdot m^{-2}$). Metabolic disturbances (e.g., dysglycaemia and dyslipidaemia) manifest at lower absolute amounts of total body fat [251]. The reason for this is unknown, but physical inactivity, imbalanced nutrition, genetic traits and perinatal adverse events are proposed as contributing factors [252]. The interplay between abdominal obesity and IR seems to be a prime candidate for explaining the increased risk of the MetS, T2D and CVD in South Asians [253]. The average BMI of 27.2 kg·m^{-2} observed in this study is therefore alarmingly high, and higher than in ethnic Norwegians [244].

The metabolic syndrome and insulin resistance

Fifty per cent of the PAMH participants had the MetS. This prevalence is higher than the prevalence rate of 29% reported by Hildrum et al. [71] in a study of > 10000 ethnic Norwegians. In the study by Hildrum et al. [71], the prevalence was highly age dependent, but even in the age group 80 to 89 years, the prevalence of the MetS was not higher than 47%. No paper has described the prevalence of the MetS among South Asians in Norway. However, a study from the UK showed a prevalence of 34% in the age group 40 to 69 years (using the WHO definition of the MetS) in a group of South Asian immigrant men without known diabetes, much higher than that in European Caucasians and other ethnic groups [90]. Zahid et al. [249] found a prevalence of 20% in a sample of 600 Pakistani men (mean age = 44 years) living in Kharian, Pakistan. Again, the genetic difference is believed to be small and the discrepancy in prevalence estimates is most likely explained by differences in lifestyle. That is, the Pakistani men living in Norway are believed to be less physically active, have easier access to energy-dense foods and have a higher waist circumference compared with men living in Kharian.

IR was highly prevalent among our relatively young participants. The mean HOMA-IR score in the PAMH study was higher than that reported by Vogeser et al. [141] for a group of obese (median BMI = 35.7 kg·m^{-2}) white Caucasians, whose mean HOMA-IR score was 3.5. Urban habits including a low PA level and high intake of energy-dense foods may be enough to induce IR, when present with only mild overweight in South Asians [195]. In multiple regression analyses (data not reported), several factors were associated with HOMA-IR score: waist circumference, sugar intake, CPM, physical inactivity and having a family member with T2D. Our observations are consistent with those of other studies showing independent roles of sedentary time [85], sugar intake [254] and CPM [254] in IR.

Taxi drivers

The differences in CPM, MVPA and peak VO_2 could explain some of the differences in health between the taxi drivers and those working in other occupations. The health differences might also relate to the occupation itself. Taxi drivers who sit in a taxi all day might not be able to take small breaks in sedentary time, which are independently associated with health benefits [86]. Many of the participants in the other occupational groups also performed sedentary work; 60% had an office job. However, they may have had more opportunities to take breaks from the sedentary time. In the other occupational group the men had a higher educational level and a higher income than the taxi drivers. A higher educational level could mean healthier choices in general, although the odds ratio for having the MetS did not change when adjusting for educational level. The health differences might also reflect other factors such as high psychological demands and low control at work [255]. The taxi drivers were more likely to report feeling depressed and stressed as barriers to participation in PA. They also had less belief in their ability to be physically active when faced with barriers compared with the other occupational group. These differences may reflect less psychological readiness for PA participation among the taxi drivers, which may explain in part the observed difference in PA level.

Research question 2

Did the intervention yield short-term effects on PA and CRF levels? (Paper II).

The PA intervention significantly improved both the PA level and the CRF level in intervention participants compared with control participants. Although the participants in the control group made progress with respect to their PA behaviour, the men in the intervention group increased their total PA level by 49 CPM and increased MVPA by about 6 min per day (≈ 42 min per week) more than control participants. This change in PA behaviour was associated with beneficial changes in postprandial serum insulin concentration and waist circumference, and is therefore considered to be of clinical significance. The results from this study show the importance of targeting PA behaviour for reducing the risk of T2D and CVD in immigrants. Lifestyle interventions have been shown to prevent T2D, but studies on immigrants are scarce. To decrease the inequalities in health we need to focus more on immigrants in the future. This study has shown that immigrants can be recruited to and will adhere to such a programme.

The PA programme used an SCT framework and was tailored to each individual's specific interests and preferences. The aim was to enable the participants to incorporate more PA into their daily routine and was developed in cooperation with representatives from the target group. The PA behaviour was targeted through multiple intervention components believed to influence potential psychosocial mediators of the change in PA and thereby the PA level. The PA behaviour was targeted through multiple components, but because we did not undertake any thorough process evaluation, we do not know the contribution of each of the various components. However, the participants were asked to rate how important the different intervention components had been for them in becoming more physically active (data not reported previously). The exercise classes, the trainer, exercising with others, and the individual counselling sessions were important in helping them to become more physically active. The phone call and written material seemed to be less important (see appendix VIII). These data lead us to conclude carefully that the following factors were vital to the success of this project in helping these men become more physically active: having access to low-threshold exercise classes, exercising with people who are similar to oneself (same level of physical fitness and skills), help in structuring the week and planning for PA, availability of professionals to help solve PA-related problems and increased knowledge of PA. Because ethnic minority populations show patterns and determinants of PA that differ from those of the majority population, duplicating successful interventions that target other groups (i.e., Caucasians) may not be adequate to ensure success. The success factor in this project may have been the participatory approach, where representatives from the targeted community participated in the planning and development of the intervention [256].

A systematic review that included studies of approaches similar to those used in the PAMH study showed a median net increase of 35% in PA level in the 18 studies investigated [257]. None of these studies used accelerometers to measure PA objectively, making it difficult to compare the results, and none of these studies was conducted with Asian immigrants. Generally, too few studies on the effectiveness of PA promotion interventions have targeted or included substantial numbers of ethnic minorities to draw any conclusions about their effects on these groups. Our results are encouraging because immigrants/ethnic minorities are considered an important target group for health interventions but are also considered a challenging group to recruit into this kind of study [202].

Adherence to the intervention was good. All the participants met for the individual counselling session, most of the men met for the group sessions (those who could not attend received written summaries of the lecture) and all were reached for the telephone follow-up. However, the attendance rate for the structured group exercises varied from 11% to 100% (mean 60%). Despite the large variability in the attendance rates in the exercise classes, we did not detect any associations between changes to the PA level or other measured variables and attendance rates.

The key reason for the beneficial changes in CRF level is most likely the increased PA level obtained through the intervention. The accumulation of MVPA gained through the intervention period, especially during the exercise classes, would presumably have been sufficient to increase peak VO_2 [258, 259].

Research question 3

Did the intervention affect other CVD risk factors? (Papers II and III).

The improved PA level was accompanied by reductions in the concentration of postprandial serum insulin and waist circumference. However, the complete MetS did not change. Insulin is the main hormone regulating glucose metabolism, and improved insulin sensitivity could reduce the risk of developing T2D. Insulin also plays an important role in regulating fat metabolism and BP. The predominant underlying risk factors for the MetS appear to be IR, abdominal obesity, ageing and physical inactivity [74]. Among these, IR could be the essential cause of the syndrome [9]. The improved insulin sensitivity, reduced waist circumference, reduced sedentary time and increased PA level observed after the five-month intervention may, in time, reduce the incidence and prevalence of the MetS in this group.

Insulin

South Asians are more insulin resistant than other ethnic groups [260], and it is hypothesized that the high prevalence of diabetes in South Asian communities is due to their increased susceptibility to developing IR [195]. The reason for this excessive IR among South Asian people is not known. However, lack of PA and an unhealthy diet followed by obesity and specific genotypes have been hypothesized as plausible factors [260]. Individuals with an IGT may initially have a high insulin level and be at increased risk for T2D. With time, the insulin level will gradually decrease in people with T2D because of a production failure [197], meaning that the PAMH participants are a high-risk population for T2D.

The insulin-2h level declined significantly in the intervention group, indicating an important reduced constraint on the insulin-secreting cells of the pancreas. As seen in other studies [261, 262], despite this appreciable reduction in the postprandial insulin response, blood glucose concentration was slightly reduced. Long- and short-term exercise studies are somewhat effective in reducing the postprandial insulin load [149, 263-265], and even very light post-meal PA may blunt the postprandial blood glucose increase [266]. A single session of strength exercise can reduce the blood glucose response to carbohydrate intake 24 h later [267]. These studies suggest that there may be appreciable short-term effects of PA on blood glucose and insulin concentrations, which may be reflected in the long-term effects observed in the present work. Because we did not ask when the participants performed their last exercise session, we do not know the extent to which the effects on insulin level were the result of a long-term adaptation to increased PA or an acute response to one session. On the other hand, we have no information to suggest group differences in the time since the last session of PA. Further studies are required to elucidate whether there is a relationship between acute and long-term blood glucose and insulin responses to PA.

The observed high baseline insulin levels indicate a high intervention potential that may partly explain the beneficial results observed in the PAMH study. Regression analyses suggested that the intervention effect on insulin level could be explained in part by the increased PA level and reduction in inactive time rather than by the reduction in waist circumference. Balkau et al. [268] also found an association between PA and insulin level, and this association remained after controlling for BMI. The strength of this latter study was the use of an accelerometer in combination with the hyperinsulinaemic-euglycaemic clamp technique for measuring insulin sensitivity. Chandalia et al. [195] demonstrated that Asian Indian men are less insulin sensitive than are Caucasians regardless of the level of total body fat. These results suggest that PA level and not fat mass is the most important factor in determining insulin sensitivity. Long-term engagement in PA may influence insulin sensitivity in many ways, i.e., by increasing the sensitivity to insulin at the receptor level and/or by promoting transduction of the insulin signal to various intracellular processes. Our study does not, however, elucidate the mechanisms responsible for the observed changes in insulin-2h levels.

The metabolic syndrome

Even though there seems to be a lack of knowledge about the metabolic effects of PA in South Asians, a recent consensus paper advocates PA as an important part of the treatment and prevention of the MetS [269]. However, as mentioned above, there seem to be some physiological differences between Caucasians and South Asians, which may explain, for example, why the latter group seems to respond differently than Caucasians to some drug treatments [194]. The physiological response to PA might also differ between South Asians and Caucasians. This question was addressed in the American Physical Activity Guidelines Advisory Committee report in 2008, which concluded that although they did not find any clinically significant differences between ethnic groups in the response to PA, too little evidence was available to draw firm conclusions [270]. In a study in England on white Europeans and South Asians, improvements in BMI, waist circumference and the concentrations of glucose-2h, HDLc and TG were beneficially associated with PA level in the white Europeans, but only waist circumference and HDLc concentration were associated with PA levels in South Asians [271]. However cross-sectional studies have found moderate level of PA to be associated with healthier levels of fasting glucose, glucose-2h and TG in Asian Indian immigrants living in the USA [187]. Misra et al. [187] and Hayes et al. [53] found no associations between PA and HDLc, BP or glucose levels in South Asians. The association between PA and waist circumference is mixed [53, 54]. PA should have had the same effect on different metabolic variables in our study group as that found in Caucasians, although this effect has not been studied thoroughly. These previous findings suggest that there are ethnicity-specific physiological differences in the response to PA. It is possible that the lack of a significant reduction in the prevalence of the MetS in the PAMH study reflects underlying ethnic differences in the physiological responses to PA [224-226]. However, evidence from the American Diabetes Prevention Program found that the risk of diabetes was reduced similarly in different ethnic groups after a lifestyle intervention [134].

The increases in PA level in the current study might be insufficient to correct the MetS factors and hence to reduce the prevalence of the MetS. The PA guidelines in many countries state that one must engage in 30 to 60 min of MVPA, preferentially on all days of the week, to avoid lifestyle-associated non-communicable diseases. The minutes of MVPA can be accumulated throughout the day but should be in episodes of > 10 min. The average amount of MVPA in the current study was 35 min for the intervention group at baseline and this increased by 13 min after the five months intervention. However, this increase in PA did not induce any significant changes in single MetS components, perhaps because improvements were also observed in the control group. When only MVPA bouts of 10 min or more were counted, only a few of the participants were sufficiently physically active, suggesting that the intermittent nature of the PA pattern among the participants might not have provided sufficient health benefits that might have occurred with longer bouts of MVPA.

The PA guidelines are mainly based on studies of Caucasians, and as discussed above, the PA dose for improving health might vary between ethnic groups. The PA guidelines are based mainly on questionnaire data and it is possible that the guidelines will be revised once the PA levels are measured objectively in diverse populations. Future studies should investigate whether the current PA guidelines are applicable to South Asians or if the guidelines should be modified for this understudied population. Of note, we observed a significantly reduced waist circumference, a key variable in the MetS definition. Reducing weight is one of the most difficult changes to achieve in T2D-prone people. We found no changes in sugar intake, but we did not control for changes in total energy intake, and therefore cannot exclude the possibility that those who increased their PA level also reduced their total energy intake.

It is also plausible that the lack of significant change in the prevalence of the MetS, and its single components could be attributed to a too-short intervention period in this target group or that the potential to cause physiological changes was low; for example, BP was well within the normal range at baseline. It is also possible that the lack of significant change in the prevalence of the MetS reflects the lack of statistical power, and that including only persons with the MetS would have produced different results.

Research question 4

Did the intervention produce long-term changes in PA behaviour? (Paper IV).

We have shown that a relatively simple PA programme can produce both short- and long-term improvements in PA level in a sedentary, overweight, male, South Asian immigrant population; these changes occurred even though the social cognitive mediators did not change markedly. The differences in CPM and MVPA between groups at FU1 were sustained and were even increased at the six month follow-up (FU2). Inactive time, which did not change significantly from baseline to FU1, decreased significantly from baseline to FU2 in the intervention group compared with the control group. A limitation of this follow-up study is the lack of anthropometric and blood measures, which preclude any conclusions about the clinical value of the increased PA level. However, the increased PA level (both CPM and MVPA) in the intervention group at FU1 was sustained at FU2, and one might expect that the improvements in waist circumference and IR demonstrated at FU1 would also be present at FU2. The current study seems to be the first to use a randomized controlled design to investigate the long-term effect of a PA intervention in this group.

Although the PA level increased from baseline to FU2, changes in the potential social cognitive mediators did not correlate with the change in PA, and mediation analysis could not be performed [241]. The lack of correlation might be because there were other unmeasured factors that mediated the change in PA such as social support from the exercise leader or perceived access to facilities. Another possible explanation is that the intervention did not adequately address the potential mediators or that the intervention was not of sufficient length to achieve greater changes in these variables. It is also possible that the social cognitive measures have not been validated in this group. Another explanation is a ceiling effect, meaning that the participants scored relatively high on many of the variables at baseline and further improvements were therefore difficult to achieve, and the small change makes it difficult to obtain significant correlations with PA. The results may also be biased because the participants were not physically active when the baseline testing was conducted and this may have made it difficult for them to answer the questions properly. The study may have lacked statistical power to show differences in these variables [272].

Compared with the control group, in the intervention group, only social support from family and outcome expectancies increased from the baseline to FU2, although the change in self-efficacy was borderline significant. This means that the participants in the intervention group reported more support for being physically active, held stronger beliefs that positive outcomes will follow participation in PA, and perceived that they had more control over being physically active when faced with barriers (e.g., time constraints). The intervention group perceived many of the PA barriers to be less of an obstacle for engaging in PA than did the control group. Although not individually correlated with changes in PA, the small differences in the aforementioned variables might together have contributed significantly to the increased engagement in PA.

Methodological considerations

Generalizability

We recruited the participants mainly through local mosques and Muslim festivals, and through information spread by word of mouth. Although not all Pakistani men in Norway are Muslims, most men attend the Friday prayer (communicated through the focus groups). The mix of different occupations included in this study may indicate that we were able to recruit people from different socio-economic groups. However, it is possible that the recruitment strategy resulted in selection bias. We excluded eight participants because of a very high PA level and 10 with diabetes. Because the participants volunteered to participate in a PA intervention, most were probably motivated to perform more PA and were perhaps more active than those who had no interest in PA and therefore did not volunteer for this project. Because persons who respond to this type of study may be motivated to increase their PA level, the external validity regarding wider populations may be questionable. Internally, however, a randomized design should prevent this from affecting the results. When comparing our data with those from Statistics Norway, the employment rate and educational level seemed to be slightly higher among the participants in the PAMH study than among Pakistani immigrant men in general. It is difficult to know whether PAMH participants are representative of the general male Pakistani community in Norway. Care should therefore be taken when trying to generalize the results. The Oslo Immigrant Health Study, in which an invitation letter was sent to all individuals in the selected age groups, achieved only a 40% response rate and found significant differences between responders and non-responders in e.g., educational level [273]. In the InnvaDiab study, efforts to recruit Pakistani women through general practitioners produced only one participant [5]. Thus, other recruitment strategies such as by invitation letter or through a general practitioner might not have reduced the selection bias.

Whether the recruitment strategy resulted in a representative sample is not known. However, it was successful in terms of creating interest in the project because about 250 men volunteered. We believe there is a strong rationale for recruiting participants by personal contact (i.e., mosques, festivals, door knocking) and not by written material (e.g., newspapers, invitation letter). Significant people in the Pakistani community spoke warmly about the project, which may have been valuable and contributed by legitimizing the project in the Pakistani community.

Study designs

Well-designed RCTs are considered the best scientific study design to evaluate cause-effect relationship and to assess the efficacy of interventions [274], although we recognize that the RCT design has some weaknesses such as contamination, threats to external validity and ethics of randomization [275]. Despite the use of a computerized randomization process, the intervention group had a significantly higher PA level and lower glucose-2h concentration at baseline and were on average almost four years younger than the control group. In theory, this could mean a lower potential for intervention which might have led to underestimation of the effects of the intervention compared with a situation in which the two groups were similar at baseline.

In the PAMH study, we strived to follow the criteria included in the PEDro (Physiotherapy Evidence Database) quality scale, which was developed to improve the reporting of RCTs. This scale includes items known to reduce bias in clinical trials such as blinding, concealed allocation and randomization [276]. However, the primary investigator and data handler was not blinded to the participants' allocation and it was not possible to satisfy the criterion of blinding the exercise instructors or the participants. RCTs that are not blinded tend to show greater intervention effects than do RCTs that have this feature [277]. In addition, participants should be studied within the group to which they were allocated independently of whether they received the treatment as allocated (intention-to-treat analysis) [278]. We performed per-protocol analysis, but we did not perform intention-to-treat analysis (i.e., we did not replace missing data). Our type of analysis provides information about the efficacy of the treatment, but may have overestimated the effect size because of selection bias [278].

The control group participants were aware of being randomized to “non-treatment” and many had relatives and/or friends in the intervention group (i.e., risk of contamination), and the Avis effect [279] (control participants initiate exercise) may have occurred. These factors may explain the increased PA level at FU1 in the control group and improvements in some blood variables. Despite the changes in the control participants, the PA level differed significantly between the two groups at the follow-up tests, thus confirming the intervention effects.

The results in paper I are based on cross-sectional data. A major weakness of this design is the inability to distinguish between cause and effect because the risk factors and the disease outcomes are measured at the same time, it is not possible to determine whether the risk factors are truly risk factors for the outcome or if they are consequences of the perceived outcome. However, cross-sectional studies are suitable for obtaining prevalence data.

Measurement errors

The baseline, FU1 and FU2 variables were measured by the same test personnel, removing any inter-rater reliability bias. A major strength of the current study is the repeated measures of PA by collecting objective data from accelerometers and CRF data by measuring oxygen consumption. Because there are no validated PA questionnaires for this group, the use of objective tools reduces the potential measurement error, although accelerometers also have some weaknesses; e.g., they underestimate upper-body movements and cycling, and do not capture water activities such as swimming. However, only a few participants in the current study reported engaging in resistance exercise, swimming and cycling, and this limitation is therefore unlikely to have influenced the results. Measuring PA over two to seven days provides only a snapshot of the participants` PA levels, and may not be representative of their actual PA level. However, in theory, the measurement error should be distributed equally between the two groups. Although three to seven days [42] is the recommended wearing time, we included the data from participants with two days of recorded accelerometer data. Because only a few participants had two days of registration, no major errors were likely to be introduced by including these participants. Another potential limitation of the accelerometer is that being monitored may increase the awareness of PA, and thus the participant may be more active than usual. Many of the participants were aware of the project goal of increasing the PA level in the intervention group. We suspect that some were more active than usual on the follow-up tests to please us (i.e., the Hawthorne effect [279]).

The questionnaires were available in both Norwegian and Urdu. If a question was perceived as being unclear, the participant could ask the test staff or other participants for help. It is our understanding that most of the participants did not ask for help when needed. This may be a cultural issue in that they did not want to trouble the staff or did not want us to know that they did not understand some things. This was also experienced during the intervention period; e.g., if we asked "do you understand?" the answer would almost always be "yes" even though they had not understood. The use of a non-validated questionnaire may have limited the possibility of finding a mediation effect. In addition, asking physically inactive participants about for example their beliefs about performing planned PA in the face of barriers could cause errors because the question would be perceived as hypothetical, especially at the baseline-testing. The food data may be imprecise because most of the men normally do not cook or shop for groceries themselves. Although more time consuming and labour demanding, a face-to-face interview with a bilingual interviewer might have attained better data.

Drop-outs

Like many other PA interventions, our study had some drop-outs. However, the drop-out rate of 11% could be considered moderate in this kind of study and is unlikely to have influenced the results because it was distributed equally between the groups. We accounted for a drop-out rate of 20% in the sample size calculation. Three more participants were lost to FU2, and an additional 33 participants failed to provide valid accelerometer recordings (leaving 65% of the original sample). This attrition must be considered high and may have caused loss of the feature of randomization [278]. Missing data can lead to exclusion of a substantial proportion of the original sample, which in turn can cause loss of precision and power [280]. Because the drop-outs (including those who did not complete the intervention and non-adherent participants) had a lower PA level, we cannot exclude the possibility that the results are an underestimation of the true impact of the intervention. Those who did drop out of the study had a lower PA level at baseline than those who did not drop out, and this might indicate that the intervention was more suitable for those who engaged in a minimum amount of PA at the start.

Power calculations

Having a sufficient sample size is crucial to determining the effects of an intervention. If the sample size is inadequate, the statistical power would be low and one might not have a sufficient number of participants to detect the effects of the intervention. The variable that the sample size calculation was based on was the difference in the change in CPM between groups. The differences in CPM between the groups at the follow-up tests confirm the assumptions made in the sample size calculations.

Recommendations

Based on the results from this thesis several recommendations seem warranted:

- Increasing the PA and CRF levels among immigrants in Norway should be a high priority to combat the burden of obesity and non-communicable diseases in this group. This is especially important for low socio-economic groups such as taxi drivers. Efforts such as free access to low-threshold organized exercise in the local community for all immigrants may be a step toward achieving this. The classes could be led by trained local residents.
- Trainers and staff should be highly dedicated and motivated.
- Untrained, unfit, obese immigrants with the MetS can participate safely in vigorous exercise classes.
- Attempts should be made to reduce sedentary time among immigrants. A first step could be to increase the number of breaks in sedentary time at work in occupations such as bus or taxi drivers by allowing them several small activity breaks during the working day.
- Face-to-face contact should be used when recruiting immigrants to interventions.
- Significant persons in the target group should be used in the recruitment and planning phases of programmes for immigrants.

- Postprandial blood glucose and insulin levels should be incorporated routinely into clinical consultations and epidemiological settings.
- Physicians should be particularly aggressive in prescribing PA to prevent diabetes in this group and should actively cooperate with relevant healthcare and physical activity personnel.
- Preventive measures should begin as early as possible.
- The immigrant population varies considerably with respect to SES, degree of integration and PA beliefs. In general one needs to understand the culture and traditions to work with immigrants, but must also take into account the diversity of this group. We must combine qualitative and quantitative data when working with immigrants, appreciate the differences and treat patients or participants as individuals.

Conclusions

- A group of Pakistani immigrant men living in Oslo, Norway, and volunteering for participation in a physical activity intervention had:
    - a low level of objectively measured physical activity and spent most of the day sedentary.
    - a low level of cardiorespiratory fitness.
    - a high prevalence of the metabolic syndrome, obesity and insulin resistance.
    - a strong positive attitude toward physical activity, but only modest belief in their ability to perform physical activity when faced with barriers, and received modest social support for being physically active.

- In the current group, a social cognitive theory based multicomponent physical activity programme:
    - increased total physical activity level and time spent in moderate- to vigorous intensity physical activity, but did not affect time spent sedentary.
    - increased cardiorespiratory fitness level.
    - reduced serum postprandial insulin and C-peptide concentrations.
    - reduced waist circumference and BMI, but did not reduce the prevalence of the metabolic syndrome.

- A social cognitive theory based PA programme in Pakistani immigrant men increased total physical activity level and time spent in moderate- to vigorous intensity physical activity, and reduce sedentary time in the long-term (six-month follow-up). Perceived social support and outcome expectancies increased, but these were not associated with the changes in physical activity.

Presumably, the beneficial effects of the intervention might reduce the risk of developing T2D in these Pakistani immigrant men.

Future research

To improve the health of immigrants living in Norway, a thorough and systematic approach to increasing PA behaviour is warranted. In the near future, we suggest the following:

- Develop feasible methods to increase the participation rate in health surveys.
- Objectively register the PA level in the largest immigrant groups.
- Prospectively quantify the dose-response relationship between PA and health.
- Develop questionnaires that are valid and reliable so that we can better investigate psychosocial and environmental mediators of, and barriers and attitudes to PA.
- In cooperation with the different communities and local politicians, develop, implement and evaluate culture-sensitive PA interventions. Efforts should be made to ensure that the activities contribute to increased integration.
- Building on the results of the evaluations, develop, implement and evaluate new large-scale interventions in close cooperation with the target group.

Epilogue

It was fantastic to see so many participants showing up and giving their very best in the group exercise classes. Many of these men had never participated in sports before or had not done so for a long time, making their achievements even more impressive. The enthusiasm, enjoyment and bonds that were forged inspired us to ensure that these men could continue to have a social meeting place and exercise together. Therefore, after the follow-up testing, Eirik Grindaker and I contacted Norges Bandyforbund (the Norwegian Bandy Federation), which agreed to finance these exercise groups further. Currently, six teams exercise twice a week. Norges Bandyforbund also conducted seven floorball tournaments for all the participants and is planning to implement two in 2011 and four in 2012. Every tournament has had at least four teams and 60 to 100 participants. For the next tournament, they will also invite the participants' families and arrange activities for the children. Now the goal is to expand to other parts of Norway and eventually to develop an internal league.

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Papers I-IV

Paper I

Low level of objectively measured physical activity and cardiorespiratory fitness, and high prevalence of metabolic syndrome among Pakistani male immigrants in Oslo, Norway

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ABSTRACT

Background: The level of physical fitness in south Asian immigrants living in Norway is largely unknown, but the level of physical activity seems to be low, possibly in part explaining their high prevalence of diabetes and cardiovascular diseases. However, previous studies have used self-reported measures of physical activity, and it might be questioned whether the previous data reflect the true physical activity level.
Aim: To describe objectively measured physical activity level, cardiorespiratory fitness and diabetes risk in a group of Pakistani immigrant men living in Oslo, Norway.
Methods: One hundred and fifty Pakistani immigrant men in the age group 25-60 years were included. Physical activity level was assessed with an accelerometer. Cardiorespiratory fitness was measured until exhaustion on a treadmill, and diabetes risk was evaluated with an oral glucose tolerance test.
Results: Mean age was 37.3 years (SD=7.7). Total physical activity level was 308 counts/min (SD=131), and peak oxygen uptake was 34.2 $ml \cdot kg^{-1} \cdot min^{-1}$ (SD=5.6). Fifty percent of the participants had the metabolic syndrome, and 76% were obese. Physical activity level and cardiorespiratory fitness level were lower, and prevalence of the metabolic syndrome higher in a subgroup of taxi drivers as compared with those in other occupations ($P<0.05$).
Conclusions: Physical activity and cardiorespiratory fitness levels are low and diabetes risk high among Pakistani immigrant men living in Oslo, especially in taxi drivers.

INTRODUCTION

People with the metabolic syndrome (MetS), a cluster of metabolic risk factors, are at high risk for developing Type 2 diabetes (T2D) and cardiovascular diseases (1). In particular, people from south Asia seem to have a high risk (2-5). Results from the "Romsås in motion" project in Oslo demonstrated a higher prevalence of self reported T2D among people from south Asia compared to ethnic Norwegians (6). The reason for this high prevalence of T2D is not known, but might be partly explained by susceptibility towards developing insulin resistance (7,8). A low level of physical activity (PA) has been observed among the south Asians in Norway (9) and this could play a key role since physical inactivity is a major cause for the development of T2D and is believed to be at the core of the MetS (10). Furthermore, the observed higher occurrence of disease among south Asian immigrants in Western countries compared with their siblings living in their home country (11) underlines the important role of unhealthy lifestyle as a crucial determinant of non-communicable diseases (not contagious diseases), such as T2D.

Since the prevalence and burden of T2D and cardiovascular diseases are especially high among south Asian immigrants in Western societies, and PA can beneficially influence T2D and cardiovascular diseases, special attention to the PA level of this population group is needed. Although studies consistently show a low level of PA among Non-Western immigrants in Norway and other Western countries (12-14), the results may be flawed by the use of self reported methods when collecting PA data. These methods carry certain weaknesses. Immigrants may find it difficult to fill in questions that are not presented in their mother tongue and they could have different perception about the PA term. In addition, the questionnaires used are often not tested for validity on immigrants. It is also difficult to obtain a precise description of the activity pattern during the day, and differences between weekdays and weekends using existing questionnaires. In addition, accurate information about duration and intensity of the activity is a problem. These are all methodological issues that can be overcome by the use of objective measurements such as an accelerometer. To our knowledge there are no papers giving objectively measured PA level in immigrants, and physical fitness is largely unknown. Based on aforementioned limitations in existing research and since physical activity seems to be crucial in the prevention of MetS/T2D, our first aim of this paper was to describe objectively measured PA pattern, cardiorespiratory fitness and diabetes risk in a group of Pakistani immigrant men living in Oslo, Norway. Furthermore, others have shown that taxi drivers are a particularly vulnerable group, expressing high coronary risk (15) and a low average expected life time (16). Our second aim was therefore to describe the physical activity pattern, cardiorespiratory fitness and diabetes risk in a subgroup of male Pakistani immigrant taxi drivers.

MATERIALS AND METHODS

The data presented in this paper are the baseline results from the "Physical activity and minority health study" which was designed as a randomized controlled trial with the main goal to increase the participants PA level.

Participants

Men living in Oslo, Norway, with a Pakistani background (either born in Pakistan or parents born in Pakistan) in the 25-60 year age group who were not very physically active (exercising at the most twice a week at a moderate or higher intensity level for 30 min or more at a time, or were active commuters) were candidates for inclusion in this study. Immigrants from Pakistan were chosen as the target group in this study because they are the largest immigrant group from south Asia in Norway (n=31061 (17)). The recruitment process was carried out during the autumn of 2008. We gave a brief oral presentation concerning the project at six mosques and at various Muslim festivals in Oslo. One hundred and eighty two men volunteered for participation in the study and of these 32 failed to meet the inclusion and exclusion criteria, giving 150 participants. Reasons for exclusion were known diabetes (n=10), being too physically active (n=8), not being able to communicate in Norwegian (n=7), too old (n=5) and having a severe injury (n=2). Before participation in the study, written informed consent was obtained from each participant. The Regional Committee for Medical Research Ethics (ref. no. S-07300b) and the Norwegian Social Science Data Services (ref. no. 17212/2/KS) both approved the study.

Measurements

The tests were carried out at the Norwegian School of Sport Sciences from October to November 2008. Waist circumference was measured, in the standing position and after a light expiration, in a straight line to the chest midway between the lower rib margin and the iliac crest. Weight was measured without shoes in light clothing by a SECA electronic scale (SECA model 767, Germany) to the nearest 0.5 kg. Height was measured without shoes with a transportable stadiometer (Harpenden; Holtain, Crymych, GB) and set to the nearest 0.5 cm. Body mass index (BMI) was calculated as weight divided by height squared (kg/m^2). Blood pressure was measured automatically using an Omega non-invasive blood pressure monitor (Invivo Research, Inc., Orlando, FL, USA) in the morning after the participant had rested for 10 min in a quiet room. Three consecutive blood pressure measurements were performed with 1 min rest between each measurement. Blood pressure was recorded as the average value of the three recordings.

Physical activity

Habitual PA was assessed with an Actigraph accelerometer (MTI model 7164; Manufacturing Technology Inc., Fort Walton Beach, FL, USA). This is a seismic instrument which continuously measures acceleration in the vertical plane, and raw data from this instrument are called "counts", which are the sum of acceleration in a given time period. The participants were instructed to wear the accelerometer for seven days on the right hip during all waking hours, except while swimming and bathing. Accelerometers were programmed to start recording at 6 am the day after the participants received their accelerometer.

The epoch length (sample interval) was set to one minute. In the analysis of accelerometer data, epoch periods with a value of zero, with two exceptions, for 60 min or longer were interpreted as "accelerometer not worn" and excluded from the analysis (18). PA data were further included if the participant had accumulated a minimum of 480 min of activity data per day. There were no differences in total physical activity (counts/min) between those who wore the monitor for two days and those who wore the monitor for three days or more. For that reason, also those participants who had worn the monitor for two days (n=7) (19) were included. Participants wore the monitor for a mean of 6.3 days (SD=1.8). Average wearing time was 13.5 hours/day (SD=1.5). Accelerometer data were processed and analyzed using the SAS-based (version 9) software program (SAS Institute Inc. Cary, North Carolina, USA) called CSA-analyzer (http://csa.svenssonsport.dk). One hundred and forty two participants had valid recordings. Four lost their monitor and four had less than two valid days of recordings. The primary outcome variable from the accelerometers is the average counts/min throughout the measurement period. Secondary outcomes are the minutes spent in various levels of PA intensity in which sedentary behavior (inactive time) was defined as ≤100 counts/min (20), light intensity activity as 101-1951, moderate intensity as 1952-5724, vigorous intensity as 5725-9497 and any amount above 9497 was considered very vigorous intensity (21). These cut points are widely used and show a good correlation (r=0.88) with direct VO_2 measurement (21). To reach the recommended level of PA one has to undertake at least 30 min of moderate to vigorous PA (MVPA) per day. The 30 min can be split into bouts of 10min. A bout was defined as 10 min or more consecutive min above 1952 counts/min with allowance for interruption of 1 or 2 min below threshold, to allow for small breaks in the activity (e.g. stop for red light).

Cardiorespiratory fitness

Cardiorespiratory fitness or Peak VO_2, defined as the highest measured VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$), was assessed through a maximum exercise test on a treadmill. We used a modified Balke protocol (22). Gas exchanges were continuously sampled in a mixing chamber every 30 s by breathing into a Hans Rudolph two-way breathing valve (2700 series, Hans Rudolph Inc, Kansas City, USA). The breathing valve was connected to a Jaeger Oxycon Pro (Erich Jaeger GmbH, Hoechberg, Germany) used to analyze the oxygen and carbon

Table 1. Summary of psychosocial variable measurements.

Variable	Number of items/ response format	Original reference source on which items were based	Cronbach`s alpha
Social support		(26)	
- family	6 / 1 (never) - 5 (very often)		0.85
- friends			0.88
Self-efficacy	7 / 1 (not at all confident) - 7 (extremely confident)	(27)	0.88
Attitude		(28,29)	
- Evaluative	5 / 1-7		0.90
- Affective	3 / 1-7		0.79
Behavioural control	3 / 1-7	(29)	0.62
Identity	3 / 1 (suits badly) – 5 (suits well)	(30)	0.74

content. The analyzer was volume- and gas-calibrated before each test. Test results was approved when scoring ≥16 on the Borg scale and when respiratory quotient was >1.1. For security reasons we tested only those under the age of 40 years (n=99).

Blood samples

After a 12-h overnight fast (minimum 8 h), between 0800 and 1030 hours, venous blood samples were drawn from an antecubital vein. Blood samples were mechanically agitated for 30 min to prevent clotting, and were then aliquoted and separated. Blood samples were centrifuged for 10 min at 2500 *g*. All samples were analyzed at FÜRST Laboratory for clinical chemistry (Oslo, Norway) the same day. An oral glucose tolerance test was performed, i.e. 75 g glucose in 200 ml of water was ingested and plasma glucose and insulin were determined before and two hours after ingestion of the glucose drink. A Modular P Machine (Roche, Japan) was used for measuring HDL cholesterol (immuno-turbidometric assay), LDL cholesterol (direct enzymatic method), triglycerides (enzymatic assay), glucose (photometric) and insulin (immunoassays).

Assessment of insulin resistance

The degree of insulin resistance was estimated by HOMA (homeostasis model assessment) according to the method described by Matthews et al. (23). Insulin resistance score (HOMA-IR) was computed with the formula: (*fasting plasma glucose x fasting serum insulin)/22.5*. Low HOMA-IR values indicate high insulin sensitivity, whereas high HOMA-IR values indicate low insulin sensitivity (insulin resistance).

Metabolic syndrome and diabetes

Metabolic syndrome was defined according to the criteria set by the international diabetes federation (10), and diabetes, impaired fasting glucose and impaired glucose tolerance are defined according to the criteria set by the American Heart Association (24).

Questionnaire data

The questions were available in both Norwegian and Urdu. If a question was unclear the participants had the possibility to ask the test staff for help. The questions covered a broad range of themes, including demographic information, health status, diet, physical activity participation and psychosocial determinants of physical activity.

Psychosocial determinants

The following potential psychosocial determinants of physical activity were measured: social support, self-efficacy, attitude, behavioural control, and identity. Measurement descriptions of these variables are summarized in Table 1. All scales were derived or modified from previously developed and validated scales (see Table 1), and additional exploratory factor analyses (principal components analysis with varimax rotation) were performed. A two-factor solution was found for the attitude scale, representing evaluative (5 items) and affective (3 items) aspects of attitude. These two factors accounted for 74.0% of the total variance. The mean score of all belonging items was computed for each scale/subscale, including participants with a response rate of 75% or greater on the respective items (25). Higher scores indicated a greater psychosocial readiness for physical activity. Generally, internal consistency properties were found satisfactory (see Table 1). Information about barriers towards PA was asked with the question; “Range how relevant the listed barriers is for you”. The scale went from zero (not a barrier) to 5 (very relevant).

Food and cola

Information about the intake of fruits, vegetables, fish and colas was obtained using the question: “Think back on the last 14 days. How often have you been eating/drinking…?” Participants were asked to indicate on a 6-point scale, ranging from “not been eating/ drinking” to “daily”, for fish and colas. For fruits and vegetables the scale also included daily frequencies with the alternatives 1, 2 and 3 times/day. In the analyses the categories “not been eating/drinking” and “<1 time/week” were consorted into one, also the categories “3-4 times/week” and “5-6 times/week” were consorted. Sugar intake was calculated as the sum of frequencies with intake of sodas, juice, fine bread, rice, pasta, jam, chocolate and snacks per week.

Statistical analysis

All statistical analyses were performed using SPSS (Statistical Package for the Social Sciences for Windows, version 15, IBM Inc. Chicago, USA). Descriptive data are presented as means, proportions and standard deviations (SD). Differences between mean values of interval data were evaluated by independent samples t-test. The results are presented as mean differences between the two groups ± confidence intervals (CI). When assessing the risk of having the MetS, we used logistic regression with MetS as the dependent variable and occupation as the independent variable under investigation, adjusted for age and education level.

RESULTS

Participants

Of the 150 participants included, 124 (83%) were not born in Norway (first generation immigrants). On average, the first generation immigrants had lived in Norway for 20 years (range 1 to 38 years). One hundred and forty three were employed (95%) and 54% had college education (Table 2). Furthermore, 93% and 81% were classified as overweight according to BMI ≥23 (31) and waist circumference ≥90 cm respectively (10).

Physical activity and cardiorespiratory fitness

Of the 142 participants with complete accelerometer data, only six (4.2%) reached the PA recommendations of 30 min of MVPA per day (PA bouts had to be of at least 10 min duration or more). Total PA level (counts/min) ranged from 86 to 847 (Table 3). There were no differences in PA between workdays and weekends. The participants spent 63% of the waking day in sedentary time (range 36% to 80%). There were no differences in any of the PA variables between the first and second generation immigrants. Peak oxygen uptake ranged from 23.4 $ml \cdot kg^{-1} \cdot min^{-1}$ to 49.1 $ml \cdot kg^{-1} \cdot min^{-1}$. Twenty participants had a peak oxygen uptake less than 30 $ml \cdot kg^{-1} \cdot min^{-1}$ and 15 had an oxygen uptake above 40 $ml \cdot kg^{-1} \cdot min^{-1}$.

Metabolic syndrome and carbohydrate metabolism

Table 4 shows the number of participants with normal and abnormal carbohydrate metabolism and the MetS. Mean fasting (5.3 mmol/l (SD=0.9)) and postprandial (6.9 mmol/l (SD=2.9)) glucose levels were within the normal range, but insulin-2h levels were very high (796 pmol/l (SD=587)) and 74% were classified as insulin resistant (HOMA-IR > 2.5 (32)). Participants with the MetS had 3.1 $ml \cdot kg^{-1} \cdot min^{-1}$ (P=0.004; 95% CI = 1.0 to 5.2) or 9% (95% CI = 3.3 to 14.6) lower peak oxygen uptake compared to those without the MetS. There was no difference between those with and without the MetS with respect to sugar intake, age or any of the PA variables. Ninety five participants had a family member with diabetes. Of these, 42 participants had one family member with diabetes, 33 had two, 15 had three and five participants had four members of the family with known diabetes.

Table 2. Characteristics of the study population (n=147-150).

Characteristic	Value
Age (years), mean (SD)	37.3 (7.7)
Education level, n (%)	
Primary school	23 (15)
High school	46 (30)
College less than 3 years	29 (19)
College more than 3 years	51 (34)
BMI (kg/m^2), mean (SD)	27.2 (3.6)
Overweight (BMI 23-24.9), (%)	16.7
Obese (BMI ≥25), (%)	76.7
Waist circumference (cm), mean (SD)	98.2 (10.0)
Triglyceride (mmol/l), mean (SD)	1.9 (1.7)
HDL cholesterol (mmol/l), mean (SD)	1.0 (0.2)
LDL cholesterol (mmol/l), mean (SD)	3.4 (0.7)
Smokers, n (%)	35 (23)

Values are mean ±SD; standard deviation, if not specified otherwise

BMI; body mass index, HDL; high density lipoprotein, LDL; low density lipoprotein

Table 3. Physical activity and physical fitness data (n=142).

Physical activity and fitness variables	Mean (SD)
Total PA (counts/min)	308 (131)
Total PA workdays (counts/min)	312 (138)
Total PA weekends (counts/min)	293 (148)
Inactive time (hours/day)	8.6 (1.6)
MVPA (min/day)	32.3 (20.8)
Moderate intensity	30.4 (18.9)
Vigorous intensity	1.8 (3.6)
Peak oxygen uptake ($ml \cdot kg^{-1} \cdot min^{-1}$)*	34.2 (5.6)

Values are mean ±SD; standard deviation

*n=99, PA; physical activity, MVPA; moderate and vigorous intensity physical activity

Table 4. Carbohydrate metabolism and metabolic syndrome.

	Cut off values		
	Fasting	2-h OGTT	n (%)
Normal[1]	< 6.1	< 7.8	106 (70)
IFG[1]	6.1 to 6.9	< 7.8	2 (1.3)
IGT[1]	< 7.0	≥ 7.8 and < 11.1	27 (18)
DM[1]	≥ 7.0	≥ 11.1	11 (7.3)
HOMA-IR			4.1 (2.4)†
MetS[2]			75 (50)
Indian risk score[3]*	≥21		81 (85.3)

[1](24), [2](10), [3](33)

n= 146 for Carbohydrate metabolism data, n= 149 for MetS data, n= 95 for Indian risk score, † mean±standard deviation, OGTT; oral glucose tolerance test, IFG; impaired fasting glucose, IGT; impaired glucose tolerance, DM; diabetes mellitus, MetS; metabolic syndrome, IDF; International Diabetes Federation, HOMA-IR; homeostasis model assessment – insulin resistance, * A score of 21 (max 42) or above is considered high risk of developing type 2 diabetes. The risk factors are high age, diabetes in the family, overweight and physical inactivity.

Table 5. Weekly intakes of colas, fruits, vegetables and fish (%), (n=144-146).

Dietary items	Not eaten/drunk	1-2 times/week	3-6 times/week	Daily
Colas*	43.8	29.2	22.9	4.2
Fruit	7.5	16.4	54.8	21.2
Vegetables	4.8	24.7	45.2	25.3
Fish	28.3	41.4	24.8	5.5

Data are presented as percentages
* Sugar containing colas

Table 6. Characteristics of the participants according to occupation.

	Taxi drivers (n=59-73)	Other occupations (n=64-76)	Mean difference ± CI	P value
Total PA level (counts/min)	269 (122)	343 (132)	-74 (-116 to -31.3)	0.001
Inactive time (hours/day)	8.4 (1.4)	8.8 (1.7)	-0.4 (-0.9 to 0.1)	0.11
MVPA (min/day)	25 (18)	38 (20)	-13 (-19 to -6.3)	<0.001
Peak oxygen uptake (ml·kg^{-1}·min^{-1})*	32.2 (3.8)	35.6 (6.2)	-3.4 (-5.5 to -1.4)	0.001
BMI (kg/m^2)	27.8 (3.3)	26.5 (3.8)	1.3 (0.2 to 2.5)	0.02
Waist circumference (cm)	100 (9)	96 (10)	4 (0.9 to 7.4)	0.01
Glucose (mmol/l)	5.5 (1.2)	5.2 (0.5)	0.3 (0.04 to 0.6)	0.02
Glucose 2h (mmol/l)	7.7 (3.3)	6.1 (2.3)	1.6 (0.6 to 2.5)	0.001
HOMA-IR	5.1 (2.7)	3.2 (1.5)	1.9 (1.1 to 2.6)	<0.001
Above 2.7 n (%)	59 (80)	43 (56)		
MetS, n (%)†	47 (64%)	27 (35%)		
Triglyceride (mmol/l)	2.4 (2.3)	1.6 (0.8)	0.8 (0.2 to 1.3)	0.009
HDL cholesterol (mmol/l)	1.0 (0.2)	1.1 (0.2)	-0.1 (0.1 to -0.03)	0.2
LDL cholesterol (mmol/l)	3.5 (0.7)	3.3 (0.7)	0.2 (-0.04 to 0.4)	0.08
Smokers, n (%)	17 (23)	18 (23)		
Years living in Norway	20.0 (9.7)	20.8 (11.4)	-0.8 (-3.6 to 2.0)	0.8

Data are adjusted for age

Values are mean ±SD; standard deviation, if not specified otherwise

* n=58 and 39, † Metabolic syndrome was defined according to the international diabetes federation cut off values. CI; confidence intervals, PA; physical activity, MVPA; moderate and vigorous intensity physical activity, MetS; metabolic syndrome, HOMA-IR; homeostasis model assessment – insulin resistance, HDL; high density lipoprotein, LDL; low density lipoprotein

Diet

Table 5 shows weekly intake of some dietary items. Sixty percent did not consume either fruit or vegetables daily, and 70% ate fish less than three times per week.

Taxi drivers

Of the 150 participants 73 (48%) worked in transport, mainly as taxi drivers (n=71). Seven other occupational areas were listed in the questionnaire: office job, restaurant/store, teaching, health sector, cleaning, craftsman and sales. Data from these occupations were consolidated into one group and compared with the taxi drivers (Table 5). The taxi drivers were on average three years older than the other occupations group (mean age = 38 (SD=7.1) and 35 (SD=7.9) respectively, P=0.01; 95% CI = 0.7 to 5.7). Compared to the other occupations group the taxi drivers had a 21.5% (95% CI = 14.6 to 28.3) lower PA level and a 9.5% (95% CI = 3.7 to 15.3) lower fitness level (Table 6). As shown in Table 6 there were statistical differences between the two groups in most of the blood variables, with a higher disease risk among the taxi drivers. There were no differences in total sugar intake between the two groups. Logistic regression analyses showed that when adjusted for age and education level the taxi drivers had a 3.6 (P=0.001; 95% CI = 1.6 to 7.8) higher odds ratio of having the MetS.

The physical activity level hour by hour on workdays and weekends within occupations are shown in Figure 1. The taxi drivers had a significantly lower PA level between the hours 0700 and 1200 (mean counts/min = 246 (SD=201) vs. 367 (SD=172), P<0.001; 95% CI = -184 to -58), and between 1500 and 1900 (mean counts/min = 274 (SD=133) vs. 404 (SD=194), P<0.001; 95% CI = -185 to -74) on workdays compared to the other occupations group.

Determinants of physical activity

The most common reported physical activities were; going for walks (39%), jogging (17%), biking (16%), ball playing (13%) and playing cricket (12%). The

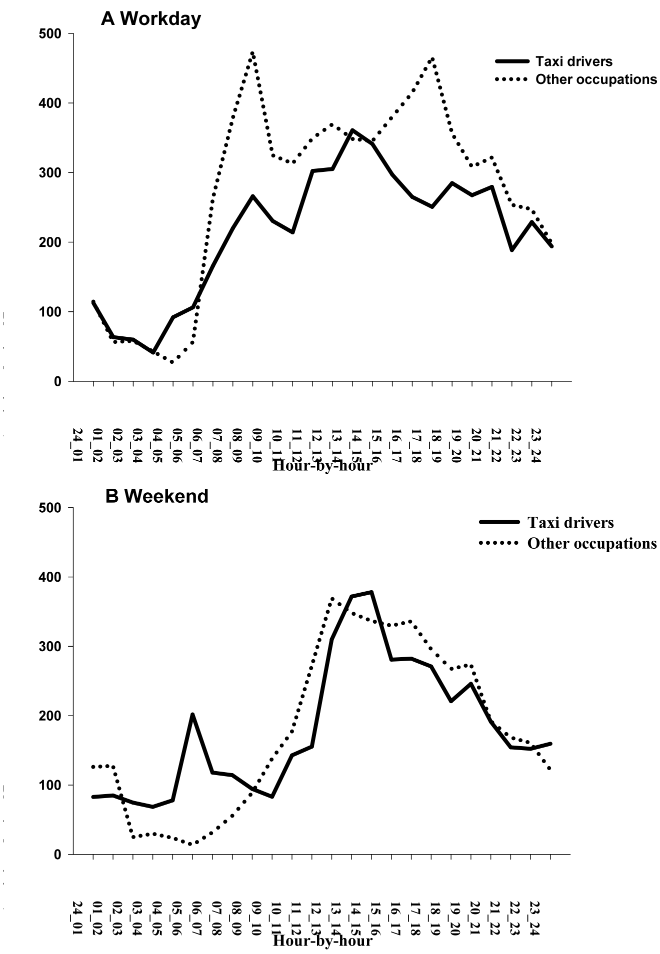

Figure 1. Hour by hour physical activity levels for taxi drivers and other occupations on A) workdays and B) weekends. The plotted values are mean physical activity level (counts/min).

most frequent listed reasons for being physically active were "getting into better shape" (82%), "not gaining weight" (73%) and "prevent disease" (60%). "Lack of time" was the most prevalent reported barrier towards being physically active, with 92% reporting this as a relevant barrier. Other common barriers were; "lack of motivation" (86%), "poor physical fitness" (80%), "bad weather" (75%) and "don't know how to do PA" (65%).

The mean scores for identity, self-efficacy, social support from family and social support from friends all fell on the center of the scale (Table 7), meaning that the participants only modestly identified themselves as physically active individuals, only modestly believed in their ability to perform physical activity when faced with barriers, and received modestly with support from people close to them for being physically active. Further, participants reported strong positive attitudes towards physical activity (Table 7).

The taxi drivers scored significantly ($P<0.05$) higher than those representing the other occupations on the following physical activity barriers: "not the sporty type", "poor physical fitness", "lack of motivation", "feel depressed", "stress", "don't know how to do PA", "don' t find any activities" and "bad health" (data not shown). The taxi drivers also reported a lower self-efficacy for physical activity participation when faced with barriers than participants from the other occupations (Table 7).

DISCUSSION

In this study we have investigated the physical activity pattern, cardiorespiratory fitness level and important health variables among a group of Pakistani immigrant men living in Oslo, Norway. We found a very low level of PA and cardiorespiratory fitness and a high prevalence of overweight and MetS. Especially the taxi drivers seem to be a group with high risk of diabetes.

Table 7. Psychosocial characteristics within occupational groups (n=141-146).

	Total	Taxi drivers	Other occupations	Mean diff ± CI	P value
Self efficacy	4.0 (1.3)	3.8 (1.4)	4.3 (1.2)	-0.5 (-0.9,-0.02)	0.03
Behavioral control	4.9 (1.3)	4.7 (1.3)	5.0 (1.1)	- 0.3 (-0.7,0.0)	0.1
Attitude, evaluative	6.3 (1.0)	6.2 (1.2)	6.4 (0.9)	-0.1 (-0.5,0.2)	0.4
Attitude, affective	5.6 (1.3)	5.6 (1.3)	5.5 (1.3)	0.1 (-0.3,0.5)	0.5
Identity	3.0 (1.0)	2.9 (1.0)	3.1 (0.9)	-0.2 (-0.5,0.1)	0.2
Social support family	3.3 (0.8)	3.2 (0.8)	3.3 (0.8)	-0.1 (-0.3,0.1)	0.4
Social support friends	3.2 (0.9)	3.3 (0.8)	3.1 (0.9)	0.2 (-0.1,0.4)	0.2

Note: Self efficacy, behavioral control and attitude range from 1 to 7; Identity and social support range from 1 to 5; Perceived social norms range from 1 to 4

Higher scores indicate a greater psychosocial readiness for physical activity

Values are mean ±SD; standard deviation

CI; confidence interval

PA level

The average PA level (counts/min) in this study was somewhat lower than reported in a nationally representative study in adults from Norway (34). Whereas the present study found an average of 308 counts/min, the national study of Anderssen et al. (34) reported a value of 333 for men and 329 for women. The PA level was higher in all age groups except for those more than 70 years. Furthermore, while only four percent of the men in our study reached the PA recommendations, 18% of the ethnic Norwegians did. Two other nationally representative studies, one from Sweden (35) and one from the USA (36), have been published. The mean counts/min were 375 (95% CI = 360 to 390) in the Swedish adult population and 377 (95% CI = 363 to 391) among the Americans. Compared to these two studies our participants had PA levels similar to that of the elderly population (60-75 age category). Furthermore, time spent sedentary was somewhat higher among our participants compared to all age groups in the Swedish and the American studies. Objectively measured PA data on south Asian immigrants does not, to our knowledge exist. However, studies using questionnaire data consistently report a low level of PA among immigrants from south Asia both in Norway (9) and the UK (12,14), confirming our results. A low level of PA, high physical inactivity and low cardiorespiratory fitness level are associated with non-communicable diseases and could explain some of the high incidence and prevalence of diabetes and cardiovascular diseases among this immigrant group.

Why the participants in our study have such a low level of PA is difficult to explain. A large part of the men in our sample have sedentary jobs and they have a long working day. The latter possible explanation is in accordance with the high percentage of the sample reporting lack of time as a barrier for being physically active. In addition, exercise or doing recreational activities (i.e. going for walks) may not be as common as among ethnic Norwegians. While only 39% of our participants were going for walks, 75% of ethnic Norwegian men do so (37). It might be that cultural attitudes and values held by the south Asian immigrants do not encourage participation in PA, although our results indicate that the participants hold strong positive attitudes towards physical activity. Identifying oneself as a physically active individual, believing in one's ability to perform physical activity, and receiving support for being physically active have repeatedly, in a number of cultural settings, been found to correlate with or mediate physical activity participation (38-40). The modest scores on these variables in the present sample may contribute in the explanation of the low level of PA.

Cardiorespiratory fitness

To our knowledge, no study measuring the cardiorespiratory fitness level among the general population in Norway has been published. However, when comparing our VO_2 peak ($ml \cdot kg^{-1} \cdot min^{-1}$) results with data obtained among healthy males in Canada, the maximal oxygen uptake among Canadians was higher in all age groups except for those aged ≥60 years (41). To establish relative VO_{2max} norms in males aged 6-75 years, Shvartz and Reibold (42) performed an extensive literature review of studies in which the maximal oxygen uptake was measured directly in healthy, untrained participants in the USA, Canada and seven European countries. The sample means were used to prepare VO_{2max} norms for all age groups. When using these data our participants would fall into the fitness category "poor" (fitness category 6, where 1 is excellent and 7 is very poor). Lakka et al. (43) found that participants having a maximal oxygen uptake below 35 $ml \cdot kg^{-1} \cdot min^{-1}$ were more likely to have the MetS than those above 35 $ml \cdot kg^{-1} \cdot min^{-1}$. This is in accordance to our findings of a significant lower VO_2 peak among those with the MetS than those without the syndrome.

Metabolic syndrome and insulin resistance

Fifty percent of our participants had the MetS. This prevalence is higher than that reported by Hildrum et al. (44) in a study of over 10000 ethnic Norwegians where they observed a prevalence rate of 29%. In the study by Hildrum et al. (44) the prevalence was highly age dependent. However, even in the age group 80-89 years the prevalence of MetS was not higher than 47%. No paper describing the prevalence of MetS among south Asians in Norway exists. However, a study from the UK showed a prevalence of 34% in the age group 40-69 years (using the WHO definition of MetS) in a group of south Asian immigrant men without known diabetes, much higher than among Europeans and other ethnic groups (45). Zahid et al. (46) found a prevalence of 20% in a sample of 600 Pakistani men living in Pakistan; the mean age was 44 years. The participants in the study by Zahid et al. (46) were from Kharian which is the same area that the participants in our study originally came from. The genetic differences is therefore believed to be small and the discrepancies in prevalence estimates could be due to differences in lifestyle, where the Pakistani men living in Norway are believed to be less physically active, have easier access to energy dense foods and have a higher waist circumference as compared with men living in Kharian.

Insulin resistance was prevalent among our relatively young participants. The mean HOMA-IR score in our study was higher compared to what Vogeser et al. (47) showed in a group of obese (median BMI = 35.7) white Caucasians where the mean HOMA-IR score was 3.5. Urban habits with low PA and high intake of energy dense foods may be enough to induce insulin resistance, even with only mild overweight in south Asians (8). In the multiple regression analyses (data not shown) several factors were associated with HOMA-IR score; waist circumference, sugar intake, total PA level, physical inactivity and having a family member with T2D. Our observations are consistent with other studies showing an independent role of sedentary time (48), sugar intake (49) and total PA (49) on insulin resistance.

Taxi drivers

The differences in total PA level, MVPA and peak VO_2 could explain some of the differences in health between the taxi drivers and the other occupational groups. The health differences could also be due to the occupation per se. Sitting in a taxi all day long means that you don't get small "breaks" in sedentary time. Healy et al. (50) showed that independent of total sedentary time and MVPA, increased breaks in sedentary time were beneficially associated with waist circumference, triglycerides and 2h plasma glucose. Many in the other occupations group also have sedentary jobs, with 60% having an office job; however, they probably have more breaks of the sedentary time. In the other occupation group the men had higher education and also a higher income than the taxi drivers. Higher education could mean better and healthier choices in general, however the odds ratio for having the MetS did not change when adjusting for education level. The health differences could also be due to other factors such as high psychological demands and low control at work (51). Accordingly, the taxi drivers to a higher degree than the other occupations group reported feeling depressed and stressed as barriers for participating in PA. The former group also to a lower extent believed in their ability to be physically active when faced with barriers compared to those representing the other occupations. These differences may reflect a somewhat lower psychological readiness for PA participation among the taxi drivers, which may contribute in explaining the observed difference in PA level.

The data presented are taken from the "Physical activity and minority health study". This study was designed as a randomized controlled trial with the main goal to increase the participants PA level. We excluded therefore eight participants due to a very high PA level and ten diabetics. Also, since the participants volunteered to a PA intervention most of them were motivated to do more PA and are perhaps more active than those who have no interest in PA and therefore did not sign up for this project. When comparing our data with data from "Statistics Norway", the employment rate and education level seem to be slightly higher among the Pakistani immigrant men in our study than generally among the Pakistani immigrant men. Based on the above it is difficult to know whether our participants are representative with respect to physical activity level, cardiorespiratory fitness and risk factors. Therefore, great care should be taken when trying to generalise the results.

CONCLUSIONS

A low level of objectively measured physical activity, a high degree of physical inactivity, a low level of cardiorespiratory fitness and a high prevalence of MetS and obesity were found in a group of Pakistani immigrant men living in Oslo, Norway. The results emphasize the importance of targeting this immigrant group, especially the taxi drivers to implement preventive measures.

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Paper II

Intervention effects on physical activity and insulin levels in Pakistani immigrant men living in Oslo: a randomised controlled trial

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Running head: Physical activity in Pakistani immigrant men

ABSTRACT

Background: High prevalence of type 2 diabetes (T2D) is seen in some immigrant groups in Western countries, particularly in those from the Indian subcontinent. Our aims were to increase the physical activity (PA) level in a group of Pakistani immigrant men, and to see whether any increase was associated with reduced serum glucose and insulin concentrations.

Methods: The intervention was developed in collaboration with the Pakistani community. It used a social cognitive theory framework and consisted of structured supervised group exercises, group lectures, individual counselling and telephone follow-up. One- hundred and fifty physically inactive Pakistani immigrant men living in Oslo, Norway, were randomised to either a control group or an intervention group. The five-month intervention focused on increasing levels of PA, which were assessed by use of accelerometer (Actigraph MTI 7164) recordings. Risk of diabetes was assessed by serum glucose and insulin concentrations determined in a fasted state, and after an oral glucose tolerance test (OGTT). ANCOVA was used to assess differences between groups.

Results: There was a mean difference in PA between the two groups of 49 counts per minute per day, representing a 15% (95% CI = 8.7 to 21.2; P = 0.01) higher increase in total PA level in the intervention group than in the control group. Insulin values taken 2 h after an OGTT were reduced in the intervention group by 27% (95% CI = 18.9 to 35.0; P = 0.02) more than those in the control group.

Conclusions: This type of intervention can increase PA and reduce serum insulin in Pakistani immigrant men, thereby presumably reducing their risk of T2D.

Keywords: Minority group, glucose, insulin, physical activity

Protocol ID: 07112001326, NCT ID: NCT00539903

Background

Immigrants comprise an increasing proportion of many Western populations. In Norway, the immigrant population is predicted to increase from currently 11% of the population, to 22-28% of the population in 2060 [1]. A higher prevalence of type 2 diabetes (T2D), which is also a main risk factor for cardiovascular disease (CVD), is seen in some immigrant groups. It seems that those who have migrated from the Indian subcontinent (Pakistan, India and Bangladesh) to Western countries, and their descendants, are particularly vulnerable to this disease [2-5]. The reason for this apparent higher disease risk is not known, but is probably attributed in part to an excess of insulin resistance [4,6,7]. Physical inactivity seems more prevalent among South Asian (SA) immigrants than in the native population [8-11] and is, together with central obesity [12], highly likely to contribute to insulin resistance [13]. A higher prevalence of T2D and other CVD risk factors among immigrants living in their new country compared with those from their country of origin may support the hypothesis that a change in lifestyle, such as lowered physical activity, is a causative factor [2,14]. While physical inactivity may be an independent risk factor for T2D, several studies suggest that physical activity (PA) may protect against developing T2D [15-17].

Little work has been done to understand why so many immigrants from SA countries are physically inactive. Lack of knowledge of the health effects of PA, socio-economic factors, language barriers and religious beliefs are some of the factors that have been linked to the PA behaviour in this group [18,19]. The few studies that have targeted ethnic minority populations, with most of these demonstrating disappointing results, have had poor methodological quality (e.g. a non-randomised design or small sample size) [18,20]. However, a common feature of the interventions that showed improvements in PA with immigrants was the input of community participants' expertise in both defining strategies and shaping interventions [18,20].

Social cognitive theory (SCT) has been acknowledged as one of the leading health behaviour change theories used to explain and predict PA [21,22]. Key SCT constructs applied to PA include the physical environment (i.e. opportunities to do PA), the social environment (i.e. social support for PA, and physically active role models), self-efficacy (i.e. confidence to do PA), outcome expectations (i.e. the values associated with being physically active), behavioural capability (i.e. knowledge and skill to do PA) and self-control (i.e. personal goal setting and monitoring of PA). However, little work has been done to apply these constructs to the PA of immigrants from SA countries. SCT-based strategies to change behaviour can include providing opportunities and social support, promoting mastery learning through skills training and approaching behaviour change in small steps, providing opportunities for goal setting and training in problem solving, and correcting misperceptions and presenting outcomes that have functional meaning. Although there is promising evidence to support the use of SCT in PA interventions, most of the behaviour change literature is based on Caucasians and may not be applicable to ethnic minorities or immigrants [23].

Because of an apparent lack of knowledge about PA behaviour among ethnic minorities, a participatory approach in the development of the intervention was considered necessary. The aims of this study therefore were to target Pakistani immigrant men living in Oslo and 1) to use a participatory approach to identify SCT influences and strategies to develop an intervention to increase PA, 2) to examine the efficacy of the intervention in increasing PA using a randomised controlled design, and 3) to examine whether increasing PA would be associated with reduced plasma glucose and insulin concentrations, thereby potentially lowering the risk of T2D.

Methods

Formative research: Physical activity influences

To better understand why many Pakistani immigrants are physically inactive and how to positively influence their PA behaviour, we conducted two focus groups with representatives from the male Pakistani immigrant group (n=10 in each group, age ranged from 25 to 60 years). Each focus group meeting lasted approximately 2 h. The aims of these group meetings were to explore expectations, expectancies, preferences and barriers to PA among the Pakistani immigrant men. These discussions revealed that: the men had very few physically active friends or family members, had little knowledge about non-vigorous PA and the link between PA and health and staying regularly physically active, had many barriers to PA (e.g. managing time) and did not know if they were able to overcome them, and they did not see many benefits of being regularly physically active. Based on these results, we decided to target the following SCT key concepts to promote PA change: environment, behavioural capability, self-control, self-efficacy, expectations and expectancies.

Participants

Men living in Oslo with a Pakistani background (either born in Pakistan or having had both parents born in Pakistan) in the 25 to 60 year age group, who were not physically active on a regular basis (exercising at most twice per week at a moderate or higher intensity level for 30 min or more at a time, or were active commuters) were candidates for inclusion in this study. Those excluded from the study were subjects with known diabetes, with injuries that would make it difficult to participate in organised exercise sessions, or who did not to speak Norwegian. The recruitment process was carried out during the autumn of 2008. We gave a brief oral presentation concerning the project at six mosques and at various Muslim festivals in Oslo. Before participation in the study, written informed consent was obtained from each participant (see Figure 1 for participant flow through the study). The Regional Committee for Medical Research Ethics (Ref. no. S-07300b) and the Norwegian Social Science Data Services (Ref. no. 17212/2/KS) approved the study.

Intervention programme

In close collaboration with representatives from the target group, we developed an intervention to target key SCT constructs via the following components: structured group exercise sessions twice a week led by an exercise physiologist, two group lectures, one individual counselling session, written material and a phone call. Table 1 provides an overview of how these components were conceptualised with reference to SCT. The intervention programme lasted five months. The control group members received their baseline results approximately two weeks after the testing, and were offered organised exercise, one group lecture and written material following completion of the intervention period.

Experimental design

Participants (n=150) were randomly assigned to either the intervention group or control group using a random computerised list. The randomisation ratio was 60:40, meaning that each participant had a 60% chance of being allocated to the intervention group. We chose this randomisation ratio in anticipation of a high dropout rate in the intervention group. We also wanted a higher power to show internal relations within the intervention group. The participants were randomly allocated to one of the two groups on the same day as the baseline assessments. Neither the test personnel nor the participants knew which group they had been assigned to until the testing was finished. The staff members involved in the intervention had to be aware of the group assignments; thus, the study was not blinded. However, the laboratory staff and data-entry personnel did not know the participants` group assignments.

Adverse effects

Throughout the intervention period there were two serious injuries (a broken leg and a disk herniation) in addition to some minor back problems. The injuries are not believed to have been caused by the exercise programme per se.

Measurements

Each participant was examined for PA habits and diabetes risk factors both before and after the five-month intervention. All testing was conducted at the Norwegian School of Sport Sciences. The baseline test was carried out in October-November 2008 and the post-test in March-May 2009. After a 12-h overnight fast (minimum 8 h), venous blood samples were drawn from an antecubital vein. An oral glucose tolerance test was performed, i.e. 75 g glucose in 200 mL of water was ingested and plasma glucose, insulin and C-peptide were determined before and 2-h after ingestion of the glucose drink. The samples were centrifuged for 10 min at 2500 *g* (except for HbA1c) and analysed the same day.

Blood variables were determined at the Dr. V. Furst Laboratory for clinical chemistry, Oslo, Norway. A Modular P Machine (Roche, Japan) was used for measuring glucose (photometry), insulin and C-peptide (immunoassays). Glycosylated haemoglobin (HbA1c) was measured on an HPLC, G7 instrument (Tosah, Japan).

Habitual PA was assessed with an MTI Actigraph accelerometer (MTI model 7164; Manufacturing Technology Inc., Fort Walton Beach, FL, USA). This is a seismic instrument that continuously measures acceleration, raw data from this instrument are called "counts", which are the sum of acceleration in a given time period. The participants were instructed to wear the accelerometer for seven days on the right hip during all waking hours, except while swimming and bathing. Accelerometers were programmed to start recording at 6 am the day after the participants received their accelerometer. The epoch length was set to 1 min. In the analysis of accelerometer data, epoch periods with a value of zero (with two exceptions) for 60 min or longer were interpreted as "accelerometer not worn" and excluded from the analysis [24,25]. Physical activity data were included if the participant had accumulated a minimum of 480 min of activity data per day for at least two days, regardless of type of day (work day or week day). There were no differences in counts per minute per day (CPM) between those who wore the monitor for two days and those who wore the monitor for three days or more. For that reason, it was decided to also include those participants who had only worn the monitor for two days (baseline; n = 7, post-test; n = 3). On average (± SD) participants wore the monitor for 6.3 ± 1.8 days at baseline and 6.1 ± 1.5 days at the post-test assessment. Average wearing time (± SD) was 13.5 ± 1.5 $h \cdot d^{-1}$ at baseline and 13.6 ± 1.6 $h \cdot d^{-1}$ at the post-test assessment. Accelerometer data were processed and analysed using the SAS-based (version 9) software program (SAS Institute Inc. Cary, North Carolina, USA) called CSA-analyser (http://csa.svenssonsport.dk). One hundred and forty-two participants had valid recordings at the baseline test (95%). Four lost their monitor and four had less than two valid days of recordings. At the post-test, 126 participants (84%) had valid recordings (intervention group n = 76, control group n = 50), 17 were lost to the post-test, five had less than two days of recordings, and two did not return their accelerometer. The primary outcome variable from the accelerometers is average CPM throughout the measurement period. Secondary outcomes are the minutes spent in various levels of PA intensity in which sedentary behaviour (inactive time) was defined as ≤ 100 counts/min [24], light intensity activity as 101-1,951 moderate intensity as 1,952-5,724, vigorous intensity as 5,725-9,497 and any amount above 9,497 is considered very vigorous intensity [26]. These cut points are widely used and show a good correlation (.88) with direct VO_2 measurement [26].

Aerobic fitness or Peak VO_2, defined as the highest measured VO_2 ($mL \cdot kg^{-1} \cdot min^{-1}$), was assessed through a maximum exercise test on a treadmill. We used a modified Balke protocol [27]. Gas exchanges were continuously sampled in a mixing chamber every 30 s by the participant breathing into a Hans Rudolph two-way breathing valve (2700 series, Hans Rudolph Inc., Kansas City, USA). The breathing valve was connected to a Jaeger Oxycon Pro (Erich Jaeger GmbH, Hoechberg, Germany) and used to analyse the oxygen and carbon dioxide content. The analyser was volume- and gas-calibrated before each test. The test result was approved when scoring ≥ 16 on the Borg 6-20-point rating of perceived exertion scale and when the respiratory quotient was > 1.1. For safety reasons, we tested only those younger than 40 years (n=99).

Waist circumference was measured at the end of a gentle expiration, in a straight line to the chest, midway between the lower rib margin and the iliac crest. Weight was measured without shoes in light clothing by a SECA electronic scale (SECA model 767, Germany) to the nearest 0.5 kg. Height was measured without shoes with a transportable stadiometer (Harpenden; Holtain, Crymych, GB) and set to the nearest 0.5 cm.

Sample size calculation

In the sample size calculation, we used PA (CPM) as the primary outcome variable. A difference in group means of 60 CPM was considered an important change. Based on data from a PA intervention conducted on obese children (data not published), a standard deviation of 120 was chosen. With a power of 0.8, a significance level of 0.05 and a presumed drop-out rate of 20%, a total of 144 participants were needed.

Statistical analysis

Means (± SD) were used to describe baseline data. Independent samples t-test was used for testing differences between groups at baseline. The response to the intervention was measured as the difference between the corresponding final and baseline values for all variables (post-baseline; per protocol analysis without imputations). Repeated measures ANCOVA was used for analysing mean changes within each group and for testing differences between mean changes in the two groups. All analyses were adjusted for age and baseline differences. Effect sizes (ES) were calculated as: (changes in the control group – changes in the intervention group)/SD in the control group. The associations between each exposure (i.e. changes in total PA and inactive time) and changes in the outcome (insulin-2h) were examined in univariate analyses using linear regression analyses. Multivariate regression analyses were used to adjust for waist circumference when looking at the relationship among changes in total PA, inactive time and changes in insulin-2 h. We analysed all data using the Statistical Package for the Social Sciences (SPSS, IBM Inc. Chicago, USA) version 15.

Results

Seventeen (11%) participants were lost to the post-test. Nine were lost from the intervention group and eight from the control group. The main reason given for not attending the post-test was lack of interest. There were no differences between drop-outs in the two groups on any variable. Except for a lower baseline PA level (CPM), the drop-outs were no different on any variable than those who completed both the baseline and the post-test.

Table 2 displays the baseline characteristics of both the control and intervention groups. A mean difference in age and glucose-2h levels between the two groups was observed. Furthermore, a difference of 46 CPM was observed in the total PA level, which translates into a 15% (95% CI = 9.1 to 20.8; P=0.05) higher PA level in the intervention group. However, there was no difference in total PA level (CPM) between the groups when adjusted for age (mean difference = 40, 95% CI = -5.6 to 85; P=0.08). The amount of moderate to vigorous PA (MVPA) was reasonably good, but of the 142 participants with complete accelerometer data, only six (4.2%) reached the PA recommendations of 30 min of MVPA per day (PA sessions had to be of at least 10 min duration or more). Fasting and postprandial glucose levels were within the normal range in both groups. Ninety-six per cent had insulin-2h levels above the health related range (18-173 pmol/L), and 93% and 81% were classified as overweight according to BMI $\geq$ 23 and waist circumference $\geq$ 90 cm, respectively.

The intervention group increased their total PA level (CPM) significantly more than the control group (Table 3). A mean difference between the two groups of 49 CPM was obtained, which translates into a 15% (95% CI = 8.7 to 21.2; P=0.01) higher increase in total PA level in the intervention group than in the control group. Moreover, the participants in the intervention group increased their time in MVPA by 6.4 min more per day, than the control group. Both groups decreased their inactive time, but there were no significant differences between the two groups in this regard.

Both groups reduced their insulin-2h levels (Table 3). In the intervention group, insulin-2h values decreased by 27% more (95% CI = 18.9 to 35.0) than in the control group. Similar findings were found for C-peptide-2h (Table 3), in which the reduction was 14% (95% CI = 7.7 to 20.2) more in the intervention group. In addition, we found significant differences between the two groups in respect to changes in weight, BMI, waist circumference and peak VO_2 (Table 3).

In univariate analyses, reductions in insulin-2h level were strongly related to changes in both total PA and inactive time (Table 4). The B-coefficients indicated reductions in insulin of 1.5 (pmol/L) for every increase in count per minute and a reduction in insulin of 1.6 (pmol/L) for every minute per day reduction in inactive time. Only minor changes were seen when adjusting for changes in waist circumference (Table 4). There was no evidence of any association between changes in insulin-2h and changes in either waist circumference, minutes in MVPA or peak VO_2 (Table 4).

Discussion

In this randomised controlled study, Pakistani immigrant men increased their total PA level and reduced their waist circumference, as well as obtaining an appreciable reduction in insulin concentration following glucose ingestion. Presumably, these changes would imply a reduced risk of T2D, and it is conceivable that an increase in the amount of PA governed the beneficial changes in serum insulin.

The strengths of this study include the randomised and controlled design and repeated measures of PA with the use of accelerometers. The intervention group had a significantly higher PA level at baseline. In theory, this could mean a lower intervention potential, thus making our intervention effects more conservative in comparison with a situation in which the two groups were similar at baseline. Because persons who respond to this type of study may be motivated to increase their PA level, the external validity regarding wider populations may be questionable. Internally, however, a randomised design should prevent this from affecting the results. Furthermore, the drop-outs had a lower PA level at baseline and this could indicate that the intervention was more suitable for those who initially engaged in a minimum of PA. Because we did not ask when the participants performed their last exercise session, we do not know the extent to which the effects on insulin were the result of a long-term adaptation to increased PA or an acute response to one session. On the other hand, we have no information to suggest group differences in time since last session of PA.

Because ethnic minority populations show patterns and determinants of PA that are different from those of the majority population, duplicating successful interventions that target other groups (i.e. Caucasians) may therefore not be adequate to ensure success. Using a participatory approach, where representatives from the targeted community participate in the planning and development of the intervention seems to be essential to ensure success [18]. To the best of our knowledge, this study is the first randomised study to target PA behaviour in an immigrant population of SA origin. Since we included a combination of individual and group counselling sessions and organised exercise, we do not know the degree of contribution of the various components. The study was based on an individually adapted health behaviour change programme that used a SCT framework and was tailored to each individual's readiness for change, specific interests and preferences. This programme had a goal of enabling the participants to incorporate more PA into their daily routine. A systematic review that included studies with approaches similar to those used in the present study showed a median net increase of 35% in PA level in the 18 studies investigated [28]. None of these studies used accelerometers as an objective measure of PA, thereby making it difficult to compare the results. Furthermore, none of these studies were conducted with Asian immigrants. Generally, very few studies on the effectiveness of PA promotion interventions have targeted or included substantial numbers of ethnic minorities in order to draw any conclusions about their effect on these groups. The few studies that have focused on immigrant groups/ethnic minorities seem to have had little or no success in increasing the PA level of the participants [20].

In insulin resistance, the ability of insulin to stimulate glucose disposal is impaired and compensated for by an increase in insulin secretion from the beta cells of the pancreas. In response to prolonged insulin resistance and the resultant hyperinsulinaemia, progressive beta-cell failure can occur, which in turn can lead to hyperglycaemia and finally diabetes. South Asians are known to be more insulin resistant than other ethnic groups [2] and it is hypothesised that the high prevalence of diabetes in SA communities is due to their increased susceptibility to developing insulin resistance [6]. The reason for this excessive insulin resistance among SA people is not known. However, lack of PA, an unhealthy diet followed by obesity, and specific genotypes have been hypothesised as plausible factors [2]. Individuals with an impaired glucose tolerance may initially have high insulin levels, and be at an increased risk for T2D. However, in the course of time the insulin levels will gradually decrease in T2D participants because of a production failure [29], meaning that our healthy participants are indeed a high-risk population for T2D, since 96% of the participants in the intervention group had above-normal insulin-2h values at baseline.

In the present study the intervention group reduced their insulin-2h levels, which most likely means an important reduced constraint on the insulin-secreting cells of the pancreas. As seen in other studies [30,31], despite this appreciable reduction in postprandial insulin response, blood glucose concentrations were slightly reduced. Long-term exercise studies have been shown to be relatively effective in reducing the postprandial insulin load [32-34]. Furthermore, even very light post-meal physical activity may blunt the postprandial blood glucose increase [35]. Additionally, a single session of strength exercise reduced the blood glucose response to carbohydrate intake 24 h later [36]. These studies suggest that there may be appreciable short-term effects of PA upon blood glucose and insulin, possibly to be reflected in the long-term effects observed in the present work. However, further studies are required to elucidate whether there is a relationship between acute and long-term blood glucose and insulin responses to PA.

The observed high baseline insulin values give a high intervention potential that may partly explain the positive results. Regression analyses have suggested that this intervention effect on insulin can be explained in part by an increased level of PA and a reduced inactive time, rather than a reduction in waist circumference. Balkau et al. (2008) also found an association between PA and insulin [37], and the relationship between total

PA and insulin sensitivity remained after controlling for BMI. The strength of this latter study was the use of an accelerometer in combination with the hyperinsulinaemic-euglycaemic clamp technique for measuring insulin sensitivity. Additionally, Chandalia et al. (1999) demonstrated that Asian Indian men are less insulin sensitive than Caucasians, regardless of their level of total body fat [6]. These results suggest that PA level and not fat mass may be the most important factor in determining insulin sensitivity. Long-term engagement in PA may influence insulin sensitivity in many ways, i.e. by increasing the sensitivity to insulin at the receptor level, and/or by promoting transduction of the insulin signal to various intracellular processes. Our study does not, however, elucidate the mechanisms behind the observed changes in insulin-2h values.

Conclusions

Using the present SCT-based PA programme, it is possible to achieve increases in PA and a reduction in serum insulin and thereby presumably reduce the risk of T2D in Pakistani immigrant men.

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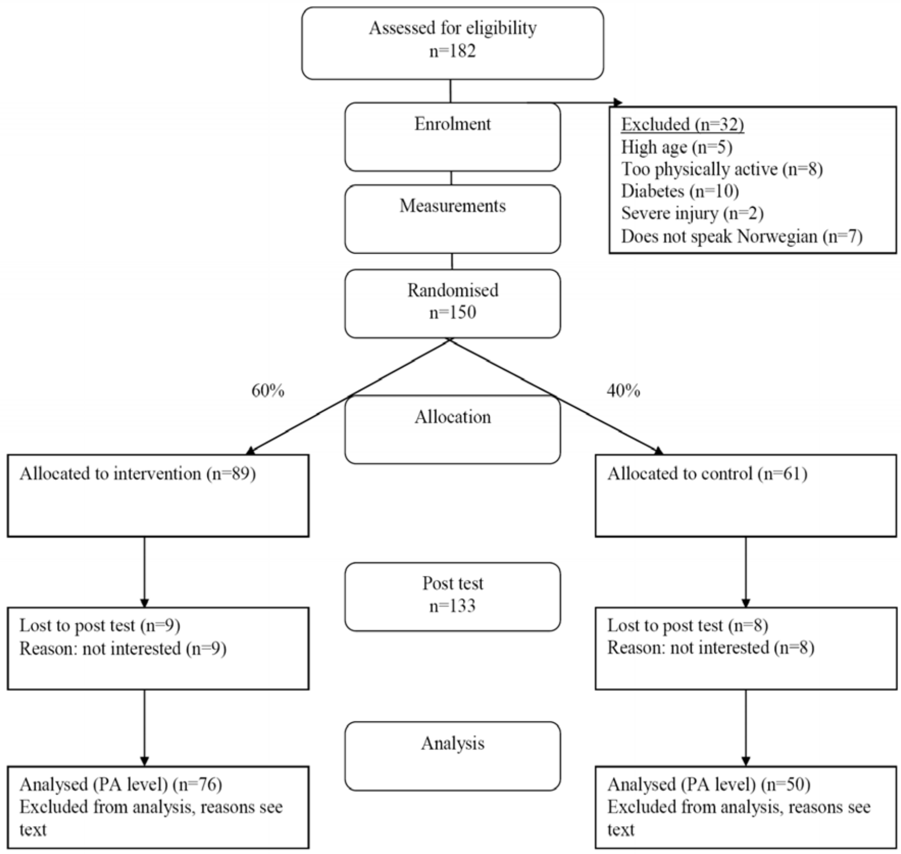

Figure 1: The flow of participants through the trial

Table 1 Overview of the intervention components, the behaviour change strategies and the targeted constructs

Intervention component	Dose	Description	Behaviour change strategy	Targeted construct
Structured group exercise	60 min 2/week	Participants could choose to attend one of five different exercise facilities in Oslo. The different exercise groups were led by an exercise physiologist. The exercise training programme was designed as a low-threshold activity. The sessions had the following structure: a 15 min warm-up with easy and fun games, 40 min of floor ball and/or football plus some strength exercises and a 5 min cool down. Seven participants did not attend any of the sessions (one trained by himself and six were not motivated) and two were injured at the first exercise session. The mean attendance was 60% (range: 11% to 100%).	-Provide opportunities for PA -Increase social support for PA -Promote mastery learning through skill training -Improve knowledge and skill to perform PA -Promote positive outcomes -Provide credible role models -Social modelling	-Environment -Behavioural capability -Expectancies -Self-control -Self-efficacy
Group lectures	2x2 h	Major topics: -What is PA? -PA and health link; short- and long-term effects -The harms of physical inactivity -PA recommendations and how to achieve these -Activity examples -Setting small goals -Identifying and reducing perceived barriers -Making a PA plan -Seeking social support -Self-reward Both attendees and non-attendees received written summaries of the lecturers.	-Improve knowledge of PA options, including non-vigorous PA -Improve knowledge of how to incorporate PA into a daily routine -Enhance PA expectancies -Improve goal setting -Improve problem solving of PA barriers -Improve social support for PA	-Behavioural capability -Expectancies -Self-control -Self-efficacy
Individual counselling sessions	1x1 h	All participants completed this part of the intervention. The counselling was based on the concept that all advice must match the participants' experiences of PA and their degree of motivation. Together with the participant, the primary goal was to find activities that could be implemented in a normal week, with the sum of these activities enabling them to reach the PA recommendations. After discussing activity options, the participants set the goals they wanted to achieve over the five-month period. Finally, we discussed barriers by asking "What do you think can stop you from carrying out this activity plan?", and the possible barriers, and solutions to them were discussed and written down.	-Identify opportunities for PA -Improve knowledge and skill to perform PA -Enhance goal setting -Enhance problem solving -Promote mastery -Identify and problem solve barriers to PA	-Environment -Behavioural capability -Self-control -Self-efficacy
Phone call	1x5-15min	Three to five weeks before the post-test, intervention participants were telephoned. The focus of this conversation was to discuss the activity plan, to make changes if necessary, and to encourage further efforts. All participants were reached within three attempts.	-Provide feedback on PA behaviour -Reinforce problem solving -Provide encouragement and help	-Social support -Self-control -Self-efficacy

Table 2 Baseline values of the primary and secondary variables in each group

Characteristic	Intervention group (n=89) Mean (SD)	Control group (n=61) Mean (SD)	Mean difference (95% CI)
Age (years)	35.7 (6.1)	39.7 (9.2)	-3.9 (-6.6 to -1.2)‡
Weight (kg)	83.7 (12)	84.1 (14.4)	-0.3 (-4.7 to 4.1)
Height (cm)	174 (6.2)	174 (6.2)	0.6 (-1.3 to 2.7)
BMI ($kg \cdot m^{-2}$)	27.1 (3.2)	27.4 (4.2)	-0.2 (-1.5 to 0.9)
Waist circumference (cm)	98 (9)	99 (11)	-1.1 (-4.6 to 2.3)
Total PA (CPM)*	328 (138)	281 (118)	46 (3 to 89)
Inactive time ($h \cdot d^{-1}$)*	8.4 (1.6)	8.9 (1.5)	-0.5 (-1.03 to 0.04)
MVPA ($min \cdot d^{-1}$) *	35 (21)	28 (19)	6.4 (-0.4 to 13)
Peak VO_2 ($mL \cdot kg^{-1} \cdot min^{-1}$)†	33.9 (5.2)	34.7 (6.5)	-0.7 (-3.4 to 1.9)
HbA1c (%)	5.6 (0.60)	5.7 (0.67)	-0.1 (-0.3 to 0.1)
Glucose (mmol/L)	5.3 (0.7)	5.5 (1.1)	-0.1 (-0.5 to 0.1
Glucose-2h (mmol/L)	6.4 (2.2)	7.6 (3.7)	-1.2 (-2.3 to-0.1)
Insulin (pmol/L)	101 (53)	107 (61)	-6 (-25 to 13)
Insulin-2h (pmol/L)	750 (607)	865 (553)	-114 (-305 to 76)
C-peptide (pmol/L)	993 (296)	1017 (346)	-23 (-131 to 83)
C-peptide-2h (pmol/L)	3688 (1348)	4057 (1369)	-368 (-820 to 83)

SD: standard deviation, BMI: body mass index, PA: physical activity, MVPA: moderate, vigorous and very vigorous intensity physical activity

* n=59 and 83 for the control and the intervention groups, respectively

† n=30 and 69 for the control and the intervention groups, respectively

Table 3 Changes between post and baseline measurements in the intervention and control groups

Characteristic	Intervention group (n range; 69-77) Δ mean (SEM)	Control group (n range; 47-53) Δ mean (SEM)	Adjusted mean diff ±95% CI*	Effect size	P-value*
Weight (kg)	-1.7 (0.2)	0.1 (0.3)	-1.9 (-2.7 to -1.0)	-0.9	<0.01
BMI ($kg·m^{-2}$)	-0.5 (0.1)	0.3 (0.1)	-0.8 (-1.1 to -0.5)	-1.00	<0.01
Waist circumference (cm)	-1.9 (0.4)	1.7 (0.4)	-3.4 (-4.7 to -2.0)	-1.06	<0.01
Total PA level (CPM)	65 (12)	19 (13)	49 (83 to 9)	0.52	0.02
Inactive time ($min·d^{-1}$)	-13 (11)	-14 (15)	11 (-28 to 50)	0.1	0.5
MVPA ($min·d^{-1}$)	13 (2)	4 (2)	6.4 (0.5 to 12)	0.44	0.04
Peak VO_2 ($mL·kg^{-1}·min^{-1}$)†	7.3 (0.4)	3.7 (0.8)	3.6 (1.8 to 5.4)	1.06	<0.01
HbA1c (%)	0.06 (0.02)	0.04 (0.03)	-0.003 (-0.1 to 0.1)	-0.02	0.9
Glucose (mmol/L)	-0.14 (0.05)	-0.06 (0.1)	-0.1 (-0.4 to 0.1)	-0.09	0.3
Glucose-2h (mmol/L)	-0.6 (0.2)	-0.6 (0.3)	-0.2 (-0.9 to 0.3)	-0.1	0.4
Insulin (pmol/L)	-15 (6.4)	-12 (5.8)	-5.5 (-24 to 12)	-0,1	0.5
Insulin-2h (pmol/L)	-257 (65)	-59 (55)	-196 (-385 to -7)	-0.51	0.04
C-peptide (pmol/L)	-75 (36)	9 (33)	-88 (-195 to 18)	-0.37	0.1
C-peptide-2h (pmol/L)	-573 (143)	-64 (153)	-445 (-886 to -6)	-0.42	0.04

SEM: standard error of the mean, CI: confidence interval, BMI: body mass index, PA: physical activity, MVPA: moderate, vigorous and very vigorous intensity physical activity

* adjusted for age and baseline differences

† n=16 and 55 for the control and the intervention groups, respectively

Table 4 Relations between changes in insulin-2h and changes in PA variables and waist circumference

Independent variables	β coefficient (±95% CI)	t-value	R^2	P value
Univariate analyses (n=102)				
Change total PA (CPM)	-1.5 (-2.4 to -0.5)	-3.2	0.091	0.002
Change inactive time ($min \cdot d^{-1}$)	1.6 (0.7 to 2.5)	3.6	0.11	<0.001
Change MVPA ($min \cdot d^{-1}$)	-4.5 (-10 to 1.7)	-1.4	0.01	0.1
Change Peak VO_2 ($mL \cdot kg^{-1} \cdot min^{-1}$)	-10 (-40 to 18)	-0.7	0.009	0.4
Change waist circumference (cm)	16 (-5.4 to 38.0)	1.4	0.019	0.14
Multivariate analyses* (n=102)				
Change total PA (CPM)	-1.4 (-2.4 to -0.4)	-3.0	0.10	0.003
Change inactive time ($min \cdot d^{-1}$)	1.6 (0.72 to 2.5)	3.7	0.13	<0.001

*Adjusted for changes in waist circumference (cm)

CI: confidence interval, MVPA: moderate and vigorous intensity physical activity

Paper III

Effect of a physical activity intervention on the metabolic syndrome in Pakistani immigrant men: a randomized controlled trial

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Running head: Physical activity and the metabolic syndrome in Pakistani immigrant men

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Abstract

Background: Physical activity (PA) is thought to prevent the metabolic syndrome (MetS), which is prevalent among south Asian immigrants in Western countries. The purpose of this study was to explore whether increasing PA improves the MetS and associated components in a group of Pakistani immigrant men living in Norway.

Methods: One- hundred and fifty physically inactive Pakistani immigrant men were randomized to either a control group (CG) or an intervention group (IG). The five- month intervention focused on increasing PA level, which was assessed using accelerometer recordings.

Results: Total PA level (counts·min^{-1}) increased significantly more in the IG than in the CG. The mean difference between the two groups was 49 counts·min^{-1}, which translates into a 15% (95% CI = 8.7% to 21.2%; P=0.01) greater increase in total PA level in the IG than in the CG. Serum insulin concentration and waist circumference decreased more in the IG compared with the CG. Other MetS related factors and the prevalence of the MetS did not differ between the groups after the intervention.

Conclusions: A five- month intervention program can increase PA level and cardiorespiratory fitness, and reduce insulin concentration and waist circumference. However this intervention program may not lower the prevalence of the complete MetS in Pakistani immigrant men.

Keywords: Metabolic syndrome, immigrant men, physical activity, randomized controlled trial

Introduction

A high prevalence of the metabolic syndrome (MetS), a clustering of metabolic abnormalities that includes glucose intolerance, dyslipidaemia and hypertension, has been reported both among south Asians residing in the Indian subcontinent (Pakistan, India and Bangladesh) [1, 2] and south Asian immigrants living in Western countries [3]. The high prevalence is a cause for concern because the syndrome predicts the development of type 2 diabetes, cardiovascular diseases and all-cause mortality [4, 5]. Factors proposed to explain this high prevalence of the MetS in this population include genetics, poor nutrition and low levels of physical activity (PA) [6]. Other factors such as a higher prevalence of insulin resistance, which seems to develop at an earlier age than in Caucasians (Europeans or other lighter-skinned populations) [7], and greater deposition of abdominal fat could also explain the higher prevalence of the MetS [7]. PA reduces the prevalence of the MetS [8, 9] and beneficially influences individual components of the syndrome. PA is widely recognized as an important part of the first- line treatment of the MetS [10]. There is a lack of PA intervention studies concerning MetS in general and among immigrants in particular. Thus, the overarching goal of the study was to evaluate the effect of PA among immigrants with respect to MetS.

A few randomized controlled trials have reported on the effect of PA on the MetS. Anderssen et al. [8] found a 23.5% reduction in the number of participants having the MetS in the exercise group vs. 11.5% reduction in the control group after a one-year exercise intervention. In the Finnish diabetes prevention it was found that those who increased moderate- to vigorous PA (MVPA) the most were more likely to show resolution of the MetS or were less likely to develop the MetS [9]. A longitudinal study by Holme et al. [11] found that baseline leisure-time PA level was a significant predictor of the MetS at the follow-up 28 years later. It has previously also been shown that increases in PA and cardiorespiratory fitness improve single risk factors included in the definition of MetS. The above-mentioned studies provide evidence of the beneficial effects of PA on the MetS and the single MetS components. However, most studies on the effect of PA on the MetS and single MetS components have been conducted on persons of American or European descent.

We found only one prospective study on the effect of PA on the MetS components in south Asians [12]. In this uncontrolled study of 40 immigrant Pakistani women with the MetS living in Australia, a 12 week diet and exercise program increased PA level and reduced BMI and plasma concentrations of glucose, insulin, total cholesterol and TG. However, the effect of PA alone was not analyzed. An association between PA and single MetS components has been reported in some cross-sectional studies of south Asians. A high number of pedometer steps are associated with lower waist circumference in Asian Indians living in New Zealand [13], and a moderate level of PA is associated with healthier levels of fasting glucose, glucose-2h and TG in Asian Indian immigrants living in the USA [14]. In this latter study, PA was not associated with HDLc concentration or blood pressure. Hayes et al. [15] found an inverse correlation between PA and insulin-2h concentration but not with BMI, waist circumference, SBP or glucose or HDLc concentrations in south Asians. A study in England on "white Europeans" and south Asians found a lower PA level in south Asians. Whereas improvements in BMI, waist circumference, and the concentrations of glucose-2h, HDLc and TG were beneficially associated with PA levels in the "white Europeans", only waist circumference and HDLc concentration were associated with PA levels in south Asians [16].

PA should have had the same effect on different metabolic variables in our study group as found in Caucasians, although this effect has not been studied thoroughly. It is possible that the lack of a significant reduction in the prevalence of the MetS reflect underlying ethnic differences in the physiological responses to PA. There is emerging evidence that black Americans gain fewer protective effects than Caucasians for a given difference in objectively measured cardiorespiratory fitness, and pedometer studies suggest that the associations between PA and adiposity are weaker in Japanese populations than Caucasians [17-19]. In contrast, evidence from the American Diabetes Prevention Program found that the risk of diabetes was similarly reduced across ethnic groups after a lifestyle intervention [20]. These previous findings suggest that there could be ethnicity-specific physiological differences in the response to PA. Such differences should be investigated further.

Even though there seems to be a lack of knowledge about the metabolic effects of PA in south Asians, a recent consensus paper advocates PA as an important part of the treatment and prevention of the MetS [21]. However, as mentioned above, there seems to be some physiological differences between Caucasians and south Asians, which may explain, for example, why the latter group seems to respond differently than Caucasians to some drug treatments [7]. The physiological response to PA might also differ between south Asians and Caucasians.

Using a participatory approach, we recently developed an intervention program with the goal of increasing the PA level in a group of Pakistani immigrant men living in Norway. We reported previously that this intervention approach increased the PA level and reduced both the postprandial insulin concentration and waist circumference (manuscript submitted for publication). This observation raised the question whether the complete MetS or single components of the MetS can be influenced by the increase in PA produced by the intervention. Based upon our previous results, the aim of this paper was to examine whether the increase in PA in this group of immigrant men was associated with beneficial effects on 1) the complete MetS, and 2) single MetS factors

Methods

The Physical Activity and Minority Health Study was a randomized controlled trial whose main goal was to increase the level of PA in a group of Pakistani immigrant men. The study protocol was approved by the Regional Committee for Medical Research Ethics (ref. no. S-07300b) and the Norwegian Social Science Data Services (ref. no. 17212/2/KS), and all study participants gave written informed consent.

Formative research: Physical activity influences

To better understand why many Pakistani immigrants are physically inactive and how to positively influence their PA behavior, we conducted two focus groups with representatives from the male Pakistani immigrant group (n = 10 in each group, age ranged from 25 to 60 years). Each focus group meeting lasted approximately 2 h. The aims of these group meetings were to explore self-efficacy, expectations, expectancies, preferences and barriers to PA among the Pakistani immigrant men. These discussions indicated that the men had very few physically active friends or family members, had little knowledge about non vigorous PA, the link between PA and health and staying regularly physically active, and identified many barriers to PA (e.g., managing time) and did not know if they were able to overcome them, and they did not see many benefits of being regularly physically active. Using these results and numerous studies showing successful changes to the PA behavior by the use of social cognitive theory (SCT) constructs [22], we decided to target three primary SCT concepts to promote PA change: self-efficacy (i.e., confidence to perform PA), outcome expectancies (i.e., expected benefits and costs of performing PA) and the social environment (i.e., social support for PA from family and friends, physically active role models). The secondary SCT components included the physical environment (opportunities to perform PA) and behavioral capability (knowledge and skill).

Participants

Men living in Oslo, Norway, with a Pakistani background (either born in Pakistan or parents born in Pakistan) in the 25 to 60 year age group who were not physically active were eligible for the study (the definition of "not physically active" was exercising no more than twice a week at a moderate or high intensity for 30 min or more at a time or active commuting (e.g., cycling or walking to work on most days of the week)). Participants were recruited during the autumn of 2008. We gave a brief oral presentation about the project at six mosques and at various Muslim festivals in Oslo. One hundred and eighty-two men volunteered to participate in the study, 32 failed to meet the inclusion and exclusion criteria, giving 150 participants. Figure 1 presents the flow of participants through the trial.

Intervention program

In close collaboration with representatives from the target group, we developed an intervention to target the key SCT constructs via the following components: structured group exercise sessions twice a week led by an exercise physiologist, two group lectures, one individual counseling session, written material and a phone call. Table 1 provides an overview of how these components were conceptualized with reference to SCT. The intervention program lasted five months. The control group members received their baseline results approximately two weeks after the testing, and were offered organized exercise, one group lecture and written material following completion of the intervention period.

Measurements

Each participant was examined for PA habits, cardiorespiratory fitness and MetS risk factors both before and after the five-month intervention. After an overnight fast, venous blood samples were drawn from an antecubital vein. Blood samples were centrifuged for 10 min at 2500 *g*. An oral glucose tolerance test was performed, in which 75 g of glucose in 200 mL of water was ingested and plasma glucose and insulin concentrations were measured before (fasting) and two hours after (postprandial) ingestion of the glucose drink. A Modular P Machine (Roche, Japan) was used to measure the concentrations of HDLc (immunoturbidimetric assay), low density lipoprotein cholesterol (LDLc) (direct enzymatic method), triglycerides (TG) (enzymatic assay), glucose (photometric assay) and insulin (immunoassay). Waist circumference was measured in the standing position and after a light expiration horizontally to the chest, midway between the lower rib margin and the iliac crest. Weight was measured without shoes in light clothing using a SECA electronic scale (SECA model 767, Germany) to the nearest 0.5 kg. Height was measured without shoes with a transportable stadiometer (Harpenden; Holtain, Crymych, UK) to the nearest 0.5 cm. Body mass index (BMI) was calculated as weight divided by height squared ($kg \cdot m^{-2}$). Blood pressure was measured automatically using an Omega non-invasive blood pressure monitor (In vivo Research, Inc., Orlando, FL., USA) in the morning after the participant had rested for 10 min in a quiet room. Three consecutive blood pressure measurements were performed with 1 min rest between each measurement. Blood pressure was recorded as the average value of the three recordings.

The Metabolic syndrome

The MetS was defined according to the criteria set by the International Diabetes Federation [10]. According to this definition, men must have central obesity, defined as waist circumference with ethnicity specific values (≥ 90 cm for south Asians) plus any two of the following four factors: serum TG concentration ≥ 1.7 $mmol \cdot L^{-1}$, HDLc concentration ≤ 1.03 $mmol \cdot L^{-1}$, systolic blood pressure (SBP) ≥ 130 mmHg or diastolic blood pressure (DBP) ≥85 mmHg or fasting plasma glucose concentration ≥ 5.6 $mmol \cdot L^{-1}$.

By this definition, a person can have a maximum of five MetS components. If a MetS component was present, it was given the value 1 and 0 if not present. For example, a value of 3 would indicate three MetS-factors.

Assessment of PA and cardiorespiratory fitness

Habitual PA was assessed with an Actigraph accelerometer (model 7164; ActiGraph, Fort Walton Beach, FL, USA). The participants were instructed to wear the accelerometer on the right hip during all waking hours for seven days except while swimming and bathing. The epoch length was set to 1 min. When analyzing the accelerometer data, epoch periods with a value of 0 for 60 min (with allowance for two exceptions above 0) or longer were interpreted as “accelerometer not worn” and removed from the analyses [23, 24]. PA data were included if the participant had accumulated a minimum of 8 hours of activity data per day for at least two days, regardless of the type of day (weekday or weekend). Accelerometer data were processed and analyzed using the SAS-based (version 9) (SAS Institute Inc. Cary, NC, USA) program CSA-Analyzer (http://csa.svenssonsport.dk). One hundred and forty-two participants had valid recordings at the baseline test (95%). Four lost their monitor and four had less than two valid days of recordings. At the post-test, 126 participants (84%) had valid recordings (intervention group n = 76, control group n = 50), 17 were lost to the post-test, five had less than two days of recordings, and two did not return their accelerometer.

Cardiorespiratory fitness was assessed by measuring oxygen consumption, which was defined as the highest measured oxygen consumption (VO_2peak in $mL \cdot kg^{-1} \cdot min^{-1}$). Oxygen consumption was measured during a maximum exercise test on a treadmill using a modified Balke protocol [25]. Gas exchange was sampled continuously into a mixing chamber every 30 s by having the participant breathe into a Hans Rudolph two-way breathing valve (2700 series, Hans Rudolph Inc., Kansas City, MO, USA) connected to a Jaeger Oxycon Pro gas analyser (Erich Jaeger GmbH, Hoechberg, Germany), which measured the oxygen and carbon dioxide content. The analyzer was volume- and gas calibrated before each test. The test result was approved when scoring ≥16 on the Borg 6-20-point rating of perceived exertion scale and when the respiratory quotient was > 1.1. For safety reasons, we tested only those younger than 40 years (n = 99).

Statistical analyses

The mean and standard deviation (SD) were used to describe baseline data. Independent samples t tests were used to test differences between groups at baseline. The response to the intervention was measured as the difference between the corresponding final and baseline values for all variables (post-baseline; per protocol analysis without imputations). Repeated measures ANCOVA was used to test differences between the mean changes in the two groups, all analyses were adjusted for age. Effect size (ES) was calculated as: (changes in the control group ÷ changes in the intervention group)/SD in the control group. We analyzed all data using the Statistical Package for the Social Sciences (version 15, IBM, Inc., Chicago, IL, USA). There was a discrepancy between the inclusion criteria and the baseline PA levels. This is due to the use of different methods to assess PA; self-report was used for screening and an accelerometer was used in the testing. By any method, they would be characterized as having a low PA level [26].

Results

Drop-outs

Seventeen (11%) participants were lost to the post-test, nine in the intervention group and eight in the control group. The main reason given for not attending the post-test was a lack of interest. Except for a lower baseline PA level (counts·min^{-1}), the drop-outs did not differ on any variable from those who completed the program and testing.

Baseline PA and metabolic characteristics

Table 2 displays the baseline characteristics for both the intervention and control groups. The prevalence of the MetS was high: 51% in the intervention group and 47% in the control group. The prevalence of the MetS and the components of the MetS did not differ significantly between the intervention and control groups. Overall, the most frequent contributing component to the MetS other than large waist circumference were low HDLc concentration (n = 79), high DBP and/or high SBP (n = 78) and high concentrations of TG (n = 69) and glucose (n = 40). Table 2 show that the men in both groups had a large waist circumference but that the levels of blood pressure and blood variables were within the normal range.

The intervention group had a higher total PA level (mean ± SD = 328 ± 138 counts·min^{-1}) than the control group (281 ± 118 counts·min^{-1}), but this was not significant after adjusting for age (40 counts·min^{-1} mean difference, 95% CI = -5.6 to 85; $P = 0.08$). The amount MVPA was 35 ± 21 min·day-1 for the intervention group and 28 ± 19 min·day-1 for the control group. Furthermore, both the intervention and control groups spent many hours each day being physically inactive (8.5 ± 1.6 and 8.9 ± 1.5 hours·day-1 respectively) and had low mean VO_2 peak values (33.9 ± 5.2 and 34.7 ± 6.5 mL·kg^{-1}·min^{-1}, respectively). None of the PA variables or cardiorespiratory fitness differed between the two groups.

Changes in metabolic characteristics and PA

The prevalence of the MetS and resolution of the MetS did not differ between the intervention and control groups after the five months (Table 3). Information about the resolution and development of the MetS components are given in Figure 2. Except for resolution of TG, no difference between the groups could be seen.

The waist circumference and insulin-2h concentration were lower after the five months in the intervention group than in the control group. The two groups did not differ significantly on any other MetS-related components after the five months (Table 4).

The mean difference in PA between the two groups after the intervention was 49 counts·min^{-1}, which translates into a 15% (95% CI = 8.7 to 21.2; *P* = 0.01) increase in total PA level in the intervention group compared with the control group. The time in MVPA increased by 6.4 min·day^{-1} (95% CI = 0.5 to 12; *P* = 0.03) and VO_2 peak by 3.6 mL·kg^{-1}·min^{-1} (95% CI = 1.8 to 5.4; *P* < 0.01) compared with the control group. Inactive time decreased in both groups and did not differ significantly between the groups after the five month.

Discussion

PA level increased following this five-month intervention program, and this increase was accompanied by increased cardiorespiratory fitness and reduced serum insulin levels and waist circumference. However, the complete MetS did not change. To our knowledge, our study is the first randomized and controlled trial to investigate the effect of PA on the MetS in a group of south Asian immigrants.

The increases in PA level in the current study might be insufficient to correct the MetS factors and hence to reduce the prevalence of the MetS. The PA guidelines in many countries state that one must engage in 30 to 60 min of MVPA, preferentially on all days of the week, to avoid lifestyle-associated non-communicable diseases. The minutes of MVPA can be accumulated throughout the day but should be in episodes of > 10 min. The average amount of MVPA in the current study was 35 min for the intervention group at baseline and this increased by 13 min after the five months intervention. However, this increase in PA did not induce any significant changes in single MetS components, perhaps because improvements were also observed in the control group. When only MVPA bouts of 10 min or more were counted, only a few of the participants were sufficiently physically active, suggesting that the intermittent nature of the PA pattern among the participants might not have provided sufficient health benefits that might have occurred with longer bouts of MVPA.

The PA guidelines are mainly based on studies of Caucasians, and the PA dose for improving health might vary depending on ethnicity. This question was addressed in the American Physical Activity Guidelines Advisory Committee report in 2008, which concluded that although they did not find any clinically significant differences between ethnic groups in the response to PA, too little evidence was available to draw firm conclusions [27]. The PA guidelines are based mainly on questionnaire data and it is possible that the guidelines will be revised once we have more objectively measured PA data on diverse populations. Future studies should investigate whether the current PA guidelines are applicable to south Asians or if the guidelines should be modified for this understudied population. Of note, we observed a significantly reduced waist circumference, a key variable in the MetS definition. Reducing weight is one of the most difficult changes to achieve in type 2 diabetes-prone people. We found no changes in sugar intake, but we did not control for changes in total energy intake, and therefore cannot rule out the possibility that those who increased their PA level also reduced their total energy intake.

It is also plausible that the lack of significant changes in the prevalence of the MetS, and its single components could be attributed to a too-short intervention period in this target group or that the potential to cause physiological changes was low; for example, blood pressure was well within the normal range at baseline.

There is some evidence that increasing PA can beneficially influence the concentration of high density lipoprotein cholesterol (HDLc) [28] and other lipids in south Asians [29]. These studies did not include a control group, and only a few cross-sectional studies have shown a correlation between PA and components of the MetS in south Asians [16, 30]. However, these studies have used self-reported measures of PA. Self-reported methods relies on the ability of the participants to recall and report PA and individuals may tend to over or under-estimate their levels of PA when they are asked to provide self-reported estimates. In addition, difficulties in demonstrating a relationship between self-reported PA and biological measurements have been reported [31]. These measurement errors are thought to be reduced by objective measurements, such as by using an accelerometer [32].

Adherence to the intervention was good. All the participants met for the individual counselling session, most of the men met for the group sessions (those who could not attend received written summaries of the lecture) and all were reached for the telephone follow-up. However, the attendance rate for the structured group exercises varied from 11% to 100% (mean 60%). Despite the large variability in the attendance rates in the exercise classes, we did not detect any associations between changes to the PA level or other measured variables and attendance rates.

Insulin is the main hormone regulating glucose metabolism, and improved insulin sensitivity could reduce the risk of diabetes. Insulin also plays an important role in regulating fat metabolism and blood pressure. The predominant underlying risk factors for the MetS appears to be insulin resistance, abdominal obesity, ageing and physical inactivity [33]. Among these, insulin resistance could be the essential cause of the syndrome [34]. The improved insulin sensitivity, reduced waist circumference, reduced sedentary time and increased PA level observed after the five-month intervention may, in time, reduce the prevalence of the MetS.

Strengths and limitations

Our study seems to be the first randomized controlled study to assess the effect of objectively measured PA on the MetS in a group of south Asians. Because there are no validated PA questionnaires for this group, the use of objective tools reduces the measurement error, although accelerometers also have some weaknesses (e.g., they underestimate the load of uphill walking and upper body movements). Like many other PA interventions, our study had some drop-outs, although the drop-out rate of 11% could be considered moderate in this kind of study and is unlikely to have influenced the results. However, since the drop-outs had a lower PA level we cannot rule out the possibility that the results are an underestimation of the true impact of the intervention. It is possible that the lack of significant changes in the MetS reflects the lack of statistical power and that including only persons with the MetS would have given different results.

Conclusions

A five-month intervention program increased PA and cardiorespiratory fitness, and reduced serum insulin concentration and waist circumference, but did not reduce the prevalence of the MetS in Pakistani immigrant men living in Norway.

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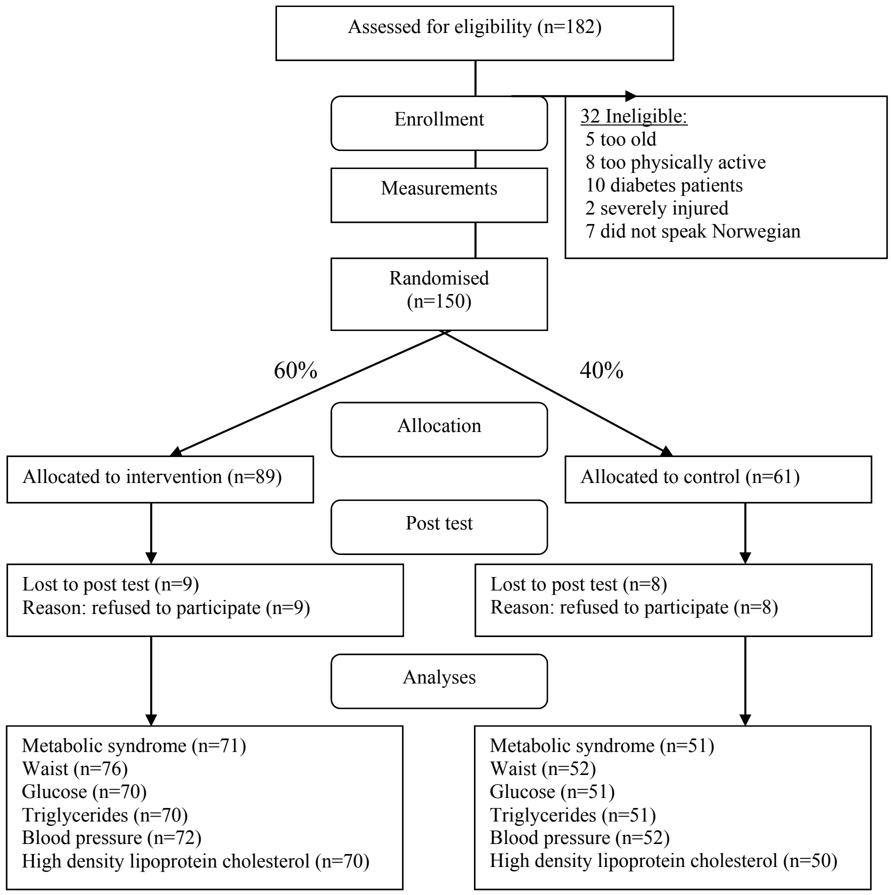

Figure 1 The flow of participants through the trial

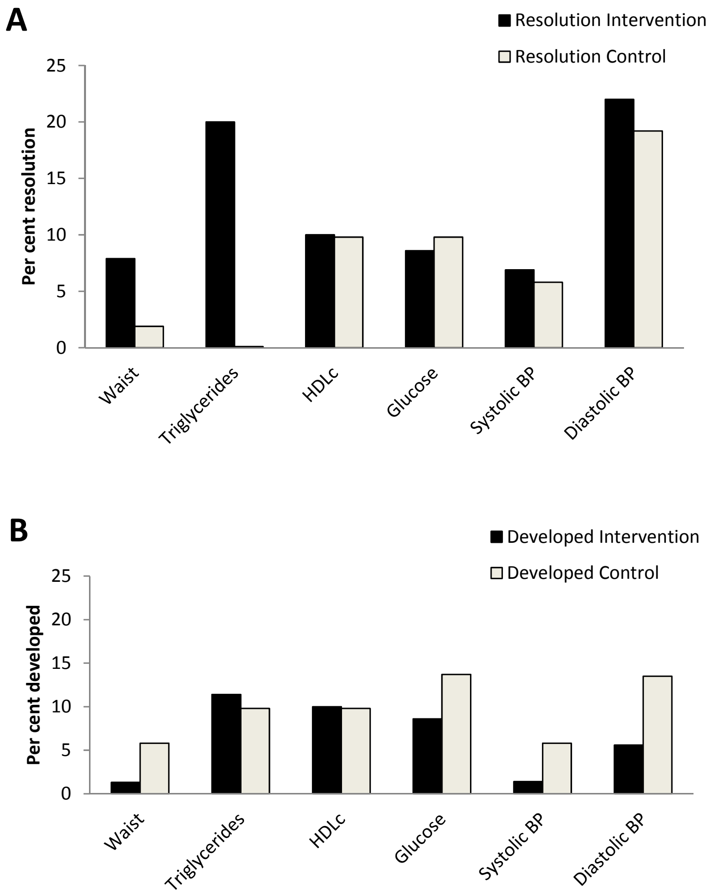

Figure 2 Incidence (%) of the resolution (A) and the development (B) of components of the metabolic syndrome during the intervention period for the intervention group (black bars) and the control group (grey bars). HDLc: high density lipoprotein cholesterol. BP: blood pressure

Table 1: Overview of the intervention components, attendance rates, behaviour change strategies and targeted social cognitive constructs.

Intervention component	Dose	Description	Behaviour change strategy	Targeted construct
Structured group exercise	60min twice a week	Participants could choose to attend one out of five different exercise facilities in Oslo. The different exercise groups were led by an exercise physiologist. The exercise training programme was designed as a low threshold activity. The sessions had the following structure: a 15 min warm-up with easy and fun games, 40 min of floorball and/or football plus some strength exercises and a 5 min cool down. Seven participants did not attend any of the sessions (one trained by himself and six were not motivated) and two were injured at the first exercise session. The mean attendance was 60% (range: 11% to 100%).	-Provide opportunities for PA -Increase social support for PA -Promote mastery learning through skill training -Improve knowledge and skill to perform PA -Promote positive outcomes of PA -Provide credible role models for PA	-Environment -Expectancies -Self-efficacy
Group lectures	2x2h	The lectures were conducted at the Norwegian School of Sports Sciences. The project leader led the classes. Major topics were: -What is PA? -PA and health link; short- and long term effects -The harms of physical inactivity -PA recommendations and how to achieve these -Activity examples -Setting small goals -Identifying and reducing perceived barriers -Making a PA plan -Seeking social support -Self reward Both attendees (95%) and non-attendees received written summaries of the lecturers.	-Improve knowledge of PA options, including non-vigorous PA -Improve knowledge on how to incorporate PA into the daily routine -Enhance PA expectancies -Improve goal setting for PA -Improve problem solving of PA barriers -Improve social support for PA	-Social support -Expectancies -Self-efficacy
Individual counselling sessions	1h	The counselling was based on the concept that all advice must match the participants' experience of PA and degree of motivation. Together with the participant, the primary goal was to find activities that could be implemented in a usual week, with the sum of these activities enabling them to reach the PA recommendations. After discussing activity options, the participants set the goals they wanted to achieve over the five-month period. Finally, we discussed barriers by asking "What do you think can stop you from carrying out this activity plan?", and the possible barriers, and solutions to them were discussed and written down. All participants completed this part of the intervention.	-Identify opportunities for PA -Improve knowledge and skill to perform PA -Enhance goal setting for PA -Promote mastery for PA -Identify and problem solve barriers to PA	-Social support -Self-efficacy -Expectancies
Phone call	5-15min	T Three to five weeks before the first follow-up test, intervention participants in the intervention group were telephoned to discuss the activity plan, to make changes if necessary, and to encourage further efforts. All participants were reached within three attempts.	-Provide feedback on PA behaviour -Reinforce problem solving for PA -Provide encouragement and help	-Social support -Self-efficacy

Table 2 Baseline descriptive characteristics of the intervention and control group.

Characteristic	Intervention group (n=89) Mean (SD)	Control group (n=61) Mean (SD)	Mean difference (95% CI)
Age (years)	35.7 (6.1)	39.7 (9.2)	-3.9 (-6.6 to -1.2)*
MetS, n (%)[1]	46 (51)	29 (47)	
No. of MetS components	2.6 (1.1)	2.5 (1.2)	0.06 (-0.3 to 0.4)
Waist circumference (cm)	98 (9)	99 (11)	-1.1 (-4.6 to 2.3)
Triglycerides ($mmol \cdot L^{-1}$)	1.9 (1.8)	2.0 (1.6)	-0.05 (-0.6 to 0.5)
HDLc ($mmol \cdot L^{-1}$)	1.0 (0.2)	1.0 (0.2)	0.0 (-0.08 to 0.09)
LDLc ($mmol \cdot L^{-1}$)	3.5 (0.6)	3.4 (0.9)	0.08 (-0.1 to 0.3)
Blood glucose ($mmol \cdot L^{-1}$)	5.3 (0.7)	5.4 (1.1)	-0.1 (-0.5 to 0.1)
Systolic BP (mmHg)	119 (11)	119 (10)	-0.6 (-4.3 to 2.9)
Diastolic BP (mmHg)	85 (9.0)	85 (10)	0.2 (-2.9 to 3.4)

Data are presented as mean (SD) if not specified otherwise. SD: standard deviation, CI: confidence interval, MetS: metabolic syndrome, HDLc: high density lipoprotein cholesterol, LDLc: low density lipoprotein cholesterol, BP: blood pressure. 1[10].

Table 3 Changes in the number of participants with the metabolic syndrome.

		Intervention group	Control group	Total
Resolution of the MetS	Number	12	7	19
	Per cent	16.9%	13.7%	15.6%
Development of the MetS	Number	8	9	17
	Per cent	11.3%	17.6%	13.9%
No change	Number	51	35	86
	Per cent	71.8%	68.6%	70.5%
Total	Number	71	51	122
	Per cent	100.0%	100.0%	100.0%

Note: Forty-six (51%) of the participants in the intervention group and 29 (47%) of the participants in the control group had the metabolic syndrome (MetS) at baseline. After the five months, 31 (34%) of the participants in the intervention group and 26 (43%) of the participants in the control group had the MetS.

Table 4 Response differences in the control and intervention groups.

Characteristic	Intervention group (n range; 69 - 77) Δ mean (SEM)	Control group (n range; 47 - 53) Δ mean (SEM)	F-value	*P*-value*	Effect size	Adjusted mean diff ±95% CI
No. of MetS components	-0.2 (0.1)	-0.03 (0.1)	0.4	0.5	-0.08	-0.1 (-0.6 to 0.3)
Waist circumference (cm)	-1.9 (0.4)	1.7 (0.4)	25.2	<0.01	-1.06	-3.4 (-4.7 to -2.0)
Triglycerides ($mmol \cdot L^{-1}$)	0.04 (0.1)	-0.02 (0.1)	0.4	0.5	0.09	0.1 (-0.2 to 0.4)
HDLc ($mmol \cdot L^{-1}$)	0.00 (0.01)	-0.01 (0.01	0.1	0.7	0.08	0.008 (-0.03 to 0.05)
LDLc ($mmol \cdot L^{-1}$)	-0.05(0.06)	0.02 (0.09)	1.1	0.2	-0.12	-0.07 (-0.3 to 0.1)
Glucose ($mmol \cdot L^{-1}$)	-0.14 (0.05)	-0.06 (0.1)	0.7	0.3	-0.09	-0.1 (-0.4 to 0.1)
Systolic BP (mmHg)	-1.7 (0.9)	0.05 (1.3)	1.0	0.3	-0.17	-1.6 (-5 to 1.6)
Diastolic BP (mmHg)	-3.8 (0.8)	-0.9 (1.0)	3.1	0.08	-0.34	-2.5 (-5.3 to 0.3)

* adjusted for age. SEM: standard error of the mean, CI: confidence intervals, MetS: metabolic syndrome, HDLc: high density lipoprotein cholesterol, LDLc: low density lipoprotein cholesterol, BP: blood pressure.

Paper IV

Physical activity levels six months after a randomised controlled physical activity intervention for Pakistani immigrant men living in Norway

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Abstract

Background: To our knowledge, no studies have aimed at improving the PA level in south Asian immigrant men residing in Western countries, and few studies have considered the relevance of SCT constructs to the PA behaviour of this group in the long term. The observed low physical activity (PA) level among south Asian immigrants in Western countries may partly explain the high prevalence of cardiovascular diseases (CVD) and type 2 diabetes (T2D) in this group. We have shown previously in a randomised controlled trial that a social cognitive based intervention can beneficially influence PA level and subsequently reduce waist circumference and insulin resistance in the short-term. In an extended follow-up of the Physical Activity and Minority Health study: we aimed 1) to determine if the intervention produced long-term positive effects on PA level six months after intervention (follow-up 2 (FU2)), and 2) to identify the social cognitive mediators of any intervention effects.

Methods: Physically inactive Pakistani immigrant men (n = 150) who were free of CVD and T2D were randomly assigned to a five months PA intervention or a control group. Six months after the intervention ended, we telephoned all those who attended FU1 and invited them for a second follow-up test (FU2) (n = 133). PA was measured using ActiGraph accelerometers. Statistical differences between groups were determined by use of ANCOVA.

Results: Significant differences (baseline to FU2) between the groups were found for all PA variables (e.g., total PA level, sedentary time, PA intensity). Support from family and outcome expectancies increased more in the intervention group compared with the control group. Self-efficacy did not differ significantly between groups.

Conclusions: Our results show that a multi component PA programme can increase PA over the short and long term in a group of immigrant Pakistani men. However, we could not identify the factors that mediated these changes in PA.

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Keywords: Physical activity, immigrants, psychosocial mediators, long term follow-up.

Introduction

Lack of moderate- to vigorous- -intensity physical activity (MVPA) is associated with a higher all-cause mortality [1] and increased risk of developing coronary heart disease [2], type 2 diabetes (T2D) [3], and the metabolic syndrome [4]. A physically active lifestyle seems to be protective [5-11]. For example, in the Finnish Diabetes Prevention Study, participants who walked for an average of 2.5 h·week^{-1} were 63% to 69% less likely to develop T2D than those who walked < 1 h·week^{-1} [12]. A follow-up study of the participants in Finnish Diabetes Prevention Study showed that the relatively brief but resource-demanding intervention reduced the incidence of T2D (relative risk reduction of 36%) many years after the intervention programme [13].

Adherence to a physically active lifestyle over the long term is essential to derive sustainable health effects. However, developing interventions where the physical activity (PA) behaviour is maintained over the long term has proven challenging. Fewer than half of those who initiate any type of PA regimen will not continue the behaviour [14], and when interventionists and the incentives they provide are no longer available, PA tends to decline with time [14].

Interventions may be more successful at inducing sustained behaviour change if they involve strategies of behaviour modification [14]. Social cognitive theory (SCT) [15] is acknowledged as one of the leading behaviour change theories to explain and predict PA in the general population [16,17] and in those with T2D [18]. The central tenet of SCT is self-efficacy (i.e., confidence to perform the behaviour), which has been consistently and positively associated with PA [19]. Another major SCT construct is outcome expectancies (i.e., the person must value the outcomes that he/she believes will occur and that these positive outcomes outweigh any negative outcomes that might also be experienced). Other SCT constructs include the physical environment, the social environment, behavioural capability, and personal regulation. PA interventions targeting these constructs may use strategies such as providing PA opportunities, social support, and skills training; identifying PA outcomes with functional meaning; and observational learning, rewards and incentives, goal setting, problem solving, and self-reward [20].

The Physical Activity and Minority Health (PAMH) study was a five month SCT based PA programme for sedentary Pakistani immigrant men living in Norway. The low levels of PA among south Asian immigrants (which includes those from Pakistan, India, Sri Lanka, Nepal, and Bangladesh) in Western countries [21-28] are likely to contribute to the high prevalence of T2D and CVD [21,22,29-36]. To our knowledge, no studies have aimed at improving the PA level in south Asian immigrant men residing in Western countries, and few studies have considered the relevance of SCT constructs to the PA behaviour of this group. As reported previously, a randomised controlled trial (RCT) of the intervention found positive short-term improvements (immediately after the intervention; follow-up 1 (FU1)) in PA level and accompanying beneficial changes in insulin sensitivity and waist circumference ([37] in press). The aims of the current study were: 1) to determine if the intervention produced long-term (six months after the intervention; follow-up 2 (FU2)) positive effects on PA level, and 2) to identify the social cognitive mediators of any intervention effects.

Methods

The design and methods of the PAMH study have been described in detail previously ([37] in press). The study protocol was approved by the Regional Committee for Medical Research Ethics (ref. no. S-07300b) and the Norwegian Social Science Data Services (ref. no. 17212/2/KS). All participants gave written informed consent.

Participants

For the original RCT, 150 participants, recruited through mosques and Muslim festivals, were randomised to either an intervention group or a control group at the baseline visit using a computer-generated list of random numbers. Pakistani (either born in Pakistan or parents born in Pakistan) immigrant men living in Oslo, Norway who were aged 25 to 60 years and who were not physically active (i.e., exercising no more than twice a week at a moderate or higher intensity for ≥ 30 min or cycling or walking to work most days of the week) were eligible for inclusion. Participants were not eligible if they had diabetes, did not speak Norwegian or had a severe injury. Seventeen participants were lost to FU1. Six months after the intervention ended, we telephoned all those who had attended FU1 and invited them to the FU2 (n = 133). Three participants declined, leaving 130 participants in the FU2 study. A scheme of the flow of participants through the trial is presented in the Figure.

Intervention programme

Using the results from two focus groups with representatives from the male Pakistani immigrant group (n = 20) ([37] in press) and numerous studies supporting the use of SCT constructs to change PA behaviour [20], we targeted three primary SCT key concepts to promote PA change: self- efficacy (i.e., confidence to perform PA), social environment (i.e., social support for PA from family and friends, physically active role models), and outcome expectancies (i.e., expected benefits and costs of performing PA). The secondary SCT components targeted included the physical environment (opportunities to perform PA) and behavioural capability (knowledge and skill). The programme included structured group exercise sessions led by an exercise physiologist twice a week, two group lectures, one individual counselling session, written material and a phone call. Table 1 provides an overview of how these strategies were linked to SCT constructs. The intervention programme lasted five months. The control group received their baseline results about two weeks after the testing, and was offered organised exercise, one group lecture and written material after the end of the intervention.

Measurements

The 130 participants who agreed to participate in the FU2 study were sent a package by mail containing a pre-programmed accelerometer and information on how and when to use it, a questionnaire and a prepaid envelope for return.

Accelerometer recordings

Free-living PA was assessed using the ActiGraph accelerometers (ActiGraph, LLC, Pensacola, FL, USA). An accelerometer is an instrument that continuously measures acceleration, and the raw data from this instrument are called "counts", which represent the sum of acceleration in a given time period. The activity monitor model 7164 was used at baseline and FU1, and the GT1M model at the FU2 test. The different types of Actigraph accelerometers have been shown to produce the same results during walking and running [38].

The primary outcome variable from the accelerometer data was the average counts per minute per day (CPM) (an indicator of the total PA level) throughout the seven-day measurement period. The secondary outcomes were the minutes spent sedentary behaviour, and in light-, moderate-, vigorous- and very vigorous-intensity PA using the following cut point (all in CPM): sedentary behaviour ≤ 100 CPM [39], light intensity PA, 101 to 1951 [40]; moderate intensity PA, 1952 to 5724; vigorous intensity PA, 5725 to 9497; and very vigorous intensity PA > 9497 [41]. These cut points are used widely and correlation with direct VO_2 measurement (r = 0.88) [41].

The participants were instructed to wear the accelerometer on the right hip during all waking hours, except while swimming and bathing, for seven days. The accelerometers were programmed to start recording at 6 am the day after the participants received their accelerometer. The epoch length (sample interval) was set to 1 min. In the analysis of accelerometer data, epoch periods with a value of zero for 60 min (with allowance for two exceptions above zero) or longer were interpreted as "accelerometer not worn" and removed from the analyses [40,42]. PA data were used if the participant had accumulated a minimum of eight hours of activity data per day for at least two days, regardless of the type of day (workday or weekends). CPM did not differ between those who wore the monitor for two days (baseline: n = 7, FU1: n = 3) and those who wore the monitor for three days or more. Subsequently, data from those participants who had worn the monitor for two days were also included [43]. Accelerometer data were processed and analysed using the SAS-based (version 9) (SAS Institute Inc. Cary, NC, USA) program CSA-Analyser (http://csa.svenssonsport.dk).

One hundred and forty-two participants (95%) had valid recordings at the baseline test: four lost their monitor and four had fewer than two valid days of recordings. At the FU1 test, 126 participants (84%) had valid recordings: 17 did not attend FU1, five had fewer than two days of recordings, and two did not return their accelerometer. Of the 130 participants at the FU2 test, we had valid accelerometer recordings on 97 (65%) of the original baseline sample: 12 participants sent the monitor back without having used it, six had fewer than two days of valid recordings and 15 did not return the monitor (Figure).

The participants wore the monitor for an average of 6.3 ± 1.8 days (mean ± standard deviation (SD)) at baseline, 6.1 ± 1.5 days at FU1, and 5.6 ± 1.6 days at FU2. The mean (± SD) wearing time was 13.5 ± 1.5 $h \cdot day^{-1}$ at baseline, 13.6 ± 1.6 $h \cdot day^{-1}$ at FU1 and 13.3 ± 1.9 $h \cdot day^{-1}$ at FU2.

Social cognitive variables

The following potential mediators of change in PA were measured by questionnaire scales: self-efficacy, social support for PA, and outcome expectancies. These variables were selected as the primary targets of the intervention. All scales were derived or modified from previously developed and validated scales (Table 2). The measurement properties of these scales are summarised in Table 2. The mean score of all relevant items was computed for each scale, for participants with a response rate of 75% or greater on the respective item [44]. Generally, internal consistency (Cronbach's alpha) properties were satisfactory (Table 2). Information about barriers to PA was collected by asking the participants to; "Rate how relevant the listed barriers are for you". The scale went from 0 (not a barrier) to 5 (very relevant).

Statistical analyses

The outcome data were analysed on a per protocol basis, without imputations. Delta PA scores and the potential psychosocial mediators were calculated (baseline to FU2), and used as the dependent variable in the analysis of covariance (ANCOVA), and with baseline measurements and age as covariates when calculating the significance of differences between the groups. Independent and paired-sample t tests were used to test differences between and within groups at the baseline, respectively, and t tests were used for the drop-out analysis. Effect sizes were calculated as: delta mean in the intervention group - delta mean in the control group / standard deviation of delta mean in the control group. According to Baron and Kenny (1986), several steps are required to demonstrate a mediation effect [45]. The criterion for a change in the hypothesised mediator to be associated with the change in PA was not met in the current study, and thus further analysis was not undertaken.

Results

Socio-demographics

Of the 150 participants at baseline, 124 (83%) were not born in Norway (first generation immigrants). The first generation immigrants had lived in Norway for an average of 20 years (range 1 to 38 years). One hundred and forty three were employed (95%), and 54% had college education. Most of the participants worked as either taxi drivers (48%) or white collar workers (31%). A high percentage of these men were overweight (93%) or obese (81%), were insulin resistant (73% scored > 2.5 in the homeostasis model assessment, developed by Matthews et al. [46]) or had the metabolic syndrome (50%), especially the taxi drivers [47]. Table 3 presents more of the baseline characteristics.

Attrition

Of the 133 participants who completed FU1, three declined the FU2 test, and 19 in the intervention group and 14 in the control group did not have valid accelerometer recordings at the FU2 test. At baseline, those with valid accelerometer recordings at FU2 (n = 97) had a lower postprandial glucose level (mean difference = - 1.2: 95% CI (confidence interval) = - 0.04 to - 2.4; P = 0.04) and fasting insulin level (mean difference = - 22: 95 % CI = – 1.0 to - 43; P = 0.04) and higher CPM (mean difference = 49: 95 % CI = 6.9 to 91; P = 0.02), compared with those with invalid accelerometer recordings at FU2 or drop-outs (n = 53).

Physical activity

Table 4 displays the PA data at all the three measurements times for the intervention and control groups. The delta differences (baseline to FU2) in all PA variables differed significantly between groups. CPM on both weekends and workdays changed more in the intervention group than in the control group. The intervention group had 84 more minutes of MVPA and 7.7 fewer hours of inactive time per week than the control group.

The intervention group increased the total PA level from baseline to the FU2 by a mean of 36 CPM (95% CI = 4 to 70; P = 0.02), an increase of 10% (95% CI = 2 to 17) and time spent in MVPA by an average of 7.3 min·day^{-1} (95% CI = 0.8 to 13.7; P = 0.03), an increase of 21% (95% CI = 10 to 31). The intervention group reduced sedentary time by a mean of 0.7 hours·day^{-1} (95% CI = -0.3 to -1.1; P = 0.001), a reduction of 9% (95% CI = 1.5 to 16). The PA variables did not change in the control group.

In the intervention group, the only significant change in PA characteristics from FU1 to FU2 was sedentary time, which was lower at the FU2 test (mean difference -0.5, 95% CI = -0.04 to -0.9; P = 0.03). In the control group, CPM (mean difference -38, 95% CI = -64 to -11; P = 0.006) and light intensity (mean difference -0.5, 95% CI = -0.9 to -0.1; P = 0.01) decreased from FU1 to FU2.

Social cognitive variables

Except for a higher score on outcome expectancies in the intervention group (mean difference = 0.6, 95% CI = 0.9 to 0.2; P < 0.01), none of the social cognitive variables differed between the two groups at baseline.

Support from family and outcome expectancies increased more from baseline to FU2 in the intervention group than in the control group (Table 5). In the intervention group the participants scored higher at FU2 on social support from family (mean difference = 0.3, 95% CI = 0.07 to 0.45; P = 0.008) and outcome expectancies (mean difference = 0.3, 95% CI = 0.08 to 0.6; P = 0.01). Self-efficacy and social support from friends did not change.

The intervention group perceived six of the 15 listed PA barriers to be less of an obstacle than did the control group. A significant change (from baseline to FU2) was found for the following barriers: time constraints (mean difference = 0.7, 95% CI = 0.0 to 1.5; P = 0.04), not the sporty type (mean difference = 1.2, 95% CI = 0.4 to 2.0; P = 0.002), lack of motivation (mean difference = 1.1, 95% CI = 0.3 to 2.0; P = 0.009), too expensive (mean difference = 1.0, 95% CI = 0.2 to 1.8; P = 0.01), don't know how (mean difference = 1.2, 95% CI = 0.3 to 2.1; P = 0.008), and don't find any activities that are okay to do (mean difference = 1.1, 95% CI = 0.3 to 2.0; P = 0.01).

Changes in the SCT constructs from baseline to FU1 did not correlate with changes in PA (CPM) from baseline to FU2 (data not shown). Therefore, mediation analysis could not be undertaken [45].

Discussion

We have shown that a relatively simple PA programme can lead to both short- and long-term improvements in PA level among a sedentary, overweight, male, south Asian immigrant population, although the social cognitive mediators did not change markedly. The differences in CPM and MVPA between groups at FU1 were sustained and even increased at the six months follow-up (FU2). Inactive time, which did not change significantly from baseline to FU1, decreased significantly from baseline to FU2 in the intervention group compared with the control group.

Although the PA level increased from baseline to FU2, changes in the potential social cognitive mediators did not correlate with the change in PA, and mediation analyses could not be performed. The lack of correlation might be because there were other unmeasured factors that mediated the change in PA such as social support from the exercise leader or perceived access to facilities. Another possible explanation is that the intervention did not adequately address the potential mediators or that the intervention was not of sufficient length to achieve greater changes in these variables. It might also be that the social cognitive measures have not been validated on this group. Another explanation is a ceiling effect, meaning that the participants scored relatively high on many of the variables at baseline and further improvements were therefore difficult to achieve, and the small changes make it difficult to obtain significant correlations with PA. The results may also be biased because the participants were not physically active when the baseline testing was conducted and this may have made it difficult for them to answer the questions properly.

Compared with the control group, in the intervention group, only social support from family and outcome expectancies increased in the intervention group from baseline to FU2, although the change in self-efficacy was borderline significant. This means that the participants in the intervention group reported more support for being physically active, stronger beliefs that positive outcomes will follow participation in PA, and the perception that they had more control over being physically active when faced with barriers (e.g., time constraints). The intervention group perceived many of the PA barriers to be less of an obstacle for engaging in PA than did the control group. Although not individually correlated with changes in PA, the small differences in the aforementioned variables might together have contributed significantly to the increased engagement in PA. These changes could have resulted from specific programme strategies such as having access to low-threshold exercise classes with people who are similar to oneself (same level of physical fitness and skills), help in structuring the week and planning for PA, professionals being available to address PA related problems (trainer), and increased knowledge of PA.

The PAMH study may be the first to investigate the effect of a PA intervention in this group using a randomised controlled design. Our results are encouraging because immigrants/ethnic minorities are considered an important group for health interventions but are also considered a challenging group to recruit into this kind of study. Some studies have addressed PA in other ethnic minority groups. In a review of 14 studies mainly on African-Americans, the interventions included a wide range of approaches: community oriented, family oriented, church based and home based [48]. Only four studies had a randomised controlled design. Overall, the results from the interventions were disappointing, and only two studies achieved changes in PA level. In the review by Taylor et al. (1998) the authors concluded that it is not clear which factors are critical for efficacious interventions but that community/participant involvement and a thorough assessment of needs, attitudes, preferences and unique barriers before the implementation of the intervention seem important [48]. Interventions should therefore be tailored specifically to the targeted ethnic group because ethnic minority populations might have specific barriers to and mediators of PA that differ from other groups [49]. The use of focus groups and people from the target group in the planning and implementation phases of the project in the PAMH study might therefore have been vital to the success of this programme.

Strengths and limitations

The PA programme used an SCT framework and was tailored to each individual's specific interests and preferences, and aimed to enable the participants to incorporate more PA into their daily routine. The PA behaviour was targeted through multiple intervention components, but because we did not undertake any process evaluation, we do not know the contribution of each of the various components. The lack of anthropometric and blood measures preclude any conclusions about the clinical value of the increased PA level. However, the increased PA level (both CPM and MVPA) in the intervention group at FU1 was sustained at FU2, and one might expect that the improvements in waist circumference and insulin resistance demonstrated at FU1 would also be present at FU2. The intervention group had a significantly higher PA level than the control group at baseline. In theory, this could mean a lower potential for intervention, which might have led to underestimation of the long-term effects compared with a situation in which the two groups were similar at baseline. A major limitation is the attrition between baseline and FU2, which may have caused loss of the feature of randomisation [50]. Those who did drop out of the study had a lower PA level at baseline than those who did not drop out, and this might indicate that the intervention was more suitable for those who engaged in a minimum of PA at the start. It was not possible to satisfy the criterion of masking the exercise instructors or the participants from group allocation. RCTs that are not blinded tend to show greater intervention effects than RCTs that have this feature [51]. Finally, persons who respond to this type of study could be motivated to increase their PA level, and so the external validity regarding wider populations may be questionable. Internally, however, a randomised design should prevent this from affecting the results.

The major strengths of this follow up study include the randomised controlled design and repeated measurement of PA using objective PA data from accelerometers. Because there are no validated PA questionnaires for this group, the use of objective tools reduces the potential measurement error. Most accelerometers show good to very good correlations (r = 0.88) with energy expenditure during walking and running [41], and activity counts from the Actigraph accelerometer correlate well (r = 0.30 to 0.96) with PA energy expenditure measured using the doubly labeled water method [52]. However, accelerometers underestimate the energy cost of running > 9 $km \cdot h^{-1}$, cycling, rowing and upper body movement [53], and do not capture water activities such as swimming. However, only a few participants in the current study reported engaging in swimming and cycling, and this limitation is therefore unlikely to have influenced the results.

Conclusions

Our results show that a multi component PA programme can increase PA in a group of immigrant Pakistani men in both the short and long term. However, we do not known what factors mediated these changes in PA.

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Table 1: Overview of the intervention components, attendance rates, behaviour change strategies and targeted social cognitive constructs.

Intervention component	Dose	Description	Behaviour change strategy	Targeted construct
Structured group exercise	60min twice a week	Participants could choose to attend one out of five different exercise facilities in Oslo. The different exercise groups were led by an exercise physiologist. The exercise training programme was designed as a low threshold activity. The sessions had the following structure: a 15 min warm-up with easy and fun games, 40 min of floor ball and/or football plus some strength exercises and a 5 min cool down. Seven participants did not attend any of the sessions (one trained by himself and six were not motivated) and two were injured at the first exercise session. The mean attendance was 60% (range: 11% to 100%).	-Provide opportunities for PA -Increase social support for PA -Promote mastery learning through skill training -Improve knowledge and skill to perform PA -Promote positive outcomes of PA -Provide credible role models for PA	-Environment -Expectancies -Self-efficacy
Group lectures	2x2h	The lectures were conducted at the Norwegian School of Sports Sciences. The project leader led the classes. Major topics were: -What is PA? -PA and health link; short- and long term effects -The harms of physical inactivity -PA recommendations and how to achieve these -Activity examples -Setting small goals -Identifying and reducing perceived barriers -Making a PA plan -Seeking social support -Self reward Both attendees (90%) and non-attendees received written summaries of the lecturers.	-Improve knowledge of PA options, including non-vigorous PA -Improve knowledge on how to incorporate PA into the daily routine -Enhance PA expectancies -Improve goal setting for PA -Improve problem solving of PA barriers -Improve social support for PA	-Social support -Expectancies -Self-efficacy
Individual counselling sessions	1h	The counselling was based on the concept that all advice must match the participants' experience of PA and degree of motivation. Together with the participant, the primary goal was to find activities that could be implemented in a usual week, with the sum of these activities enabling them to reach the PA recommendations. After discussing activity options, the participants set the goals they wanted to achieve over the five-month period. Finally, we discussed barriers by asking "What do you think can stop you from carrying out this activity plan?", and the possible barriers, and solutions to them were discussed and written down. All participants completed this part of the intervention.	-Identify opportunities for PA -Improve knowledge and skill to perform PA -Enhance goal setting for PA -Promote mastery for PA -Identify and problem solve barriers to PA	-Social support -Self-efficacy -Expectancies
Phone call	5-15min	Three to five weeks before the first follow-up test, intervention participants in the intervention group were telephoned to discuss the activity plan, to make changes if necessary, and to encourage further efforts. All participants were reached within three attempts.	-Provide feedback on PA behaviour -Reinforce problem solving for PA -Provide encouragement and help	-Social support -Self-efficacy

Table 2 Measurement properties of psychosocial scales.

Variable	Number of items / response format	Example of sample items	Original reference source on which items were based	Cronbach`s alpha Baseline, FU1 and FU2 (range)
Social support		Have your family/friends…	[54]	
- family	6 / 1 (never) - 5 (very often)	… Encouraged you to be physically active?		0.85-0.87
- friends	6 / 1 (never) - 5 (very often)			0.87-0.88
Self-efficacy	7 / 1 (not at all confident) - 7 (very confident)	I am confident I can participate in planned physical activity when… I am tired	[55]	0.87-0.89
Outcome expectancies	6 / 1 (unlikely) – 7 (very likely)	If I am regularly physically active in the next month… Iwill get in better shape		0.85-0.89

Table 3 Baseline characteristics for the intervention and the control group.

Characteristic	Intervention group (n=89)	Control group (n=61)	Mean difference (95% CI)
Age (years)	35.7 (6.1)	39.7 (9.2)	-3.9 (-6.6 to -1.2)*
Weight (kg)	83.7 (12)	84.1 (14.4)	-0.3 (-4.7 to 4.1)
Height (cm)	174 (6.2)	174 (6.2)	0.6 (-1.3 to 2.7)
BMI ($kg \cdot m^{-2}$)	27.1 (3.2)	27.4 (4.2)	-0.2 (-1.5 to 0.9)
Waist circumference (cm)	98 (9)	99 (11)	-1.1 (-4.6 to 2.3)
Peak VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$)†	33.9 (5.2)	34.7 (6.5)	-0.7 (-3.4 to 1.9)

Values are mean (standard deviation). The independent-sample t test was used to calculate significance of the difference between groups. CI; confidence interval, BMI; body mass index. * P = 0.005. † n=30 and 69 for the control and the intervention groups, respectively.

Table 4 Mean and standard deviation of physical activity data at the three measurement times.

	Intervention group			Control group					
	Baseline	FU1	FU2	Baseline	FU1	FU2	Adjusted Δ diff (95% CI)*	Effect size	P-value
Total PA level (CPM)	328 (138)	407 (149)	389 (137)	281 (118)	317 (129)	260 (99)	81 (36 to 126)	0.64	0.001
PA level on weekends (CPM)†	304 (150)	422 (188)	370 (150)	278 (142)	319 (147)	249 (136)	124 (44 to 203)	0.47	0.003
PA level on weekdays (CPM)	332 (143)	407 (157)	388 (148)	283 (128)	320 (144)	265 (98)	72 (23 to 120)	0.48	0.004
Sedentary time (hours·day^{-1})	8.4 (1.6)	7.9 (1.8)	7.7 (1.5)	8.9 (1.5)	8.9 (1.5)	9.3 (1.4)	-1.1 (-1.8 to -0.5)	-0.23	0.001
Light intensity PA (hours·day^{-1})	4.5 (1.4)	5.0 (1.2)	5.0 (1.2)	4.0 (1.0)	4.0 (1.1)	3.6 (1.0)	1.1 (0.6 to 1.6)	0.64	<0.001
MVPA (min·day^{-1})	35 (21)	46 (23)	44 (23)	28 (19)	33 (21)	27 (17)	12 (4.4 to 21.1)	0.72	0.003

* Difference (baseline to FU2), all variables were adjusted for their respective baseline value and age. ANCOVA was used to analyse the data. † n = 41 and 30 at the FU2 for the intervention and the control groups, respectively. PA; physical activity, CPM; counts per min, MVPA; moderate and vigorous physical activity, CI; confidence interval. FU1; follow-up 1 (conducted immediately after the intervention), FU2; follow-up 2 (conducted six months after the intervention).

Table 5 Mean and standard deviation of social cognitive variables at all the three measurement times.

	Intervention group			Control group					
	Baseline (n=79-88)	FU1 (n=71-74)	FU2 (n=53-56)	Baseline (n=54-58)	FU1 (n=47-52)	FU2 (n=37-39)	Adjusted Δ diff (95% CI)*	Effect size	P-value
Social support									
- family	3.4 (0.8)	3.6 (0.8)	3.6 (0.9)	3.1 (0.8)	3.2 (0.7)	3.1 (0.6)	0.4 (0.1 to 0.7)	0.65	0.001
- friends	3.2 (0.9)	3.2 (0.9)	3.2 (0.8)	3.1 (0.9)	3.3 (0.8)	3.3 (0.8)	-0.1 (-0.4 to 0.1)	-0.12	0.4
Self-efficacy	4.1 (1.4)	4.1 (1.4)	4.1 (1.4)	3.8 (1.1)	3.9 (1.1)	3.5 (1.3)	0.5 (-0.1 to 1.1)	0.44	0.09
Outcome expectancies	6.3 (0.8)	6.4 (0.6)	6.5 (0.6)	5.7 (1.0)	5.7 (1.2)	5.7 (1.0)	0.7 (0.2 to 1.3)	0.38	0.01

* Difference (baseline to FU2), all variables were adjusted for their respective baseline value and age. ANCOVA was used to analyse the data. CI; confidence interval. FU1; follow-up 1 (conducted immediately after the intervention), FU2; follow-up 2 (conducted six months after the intervention). Note; Self efficacy and outcome expectancies range from 1 to 7; Social support range from 1 to 5.

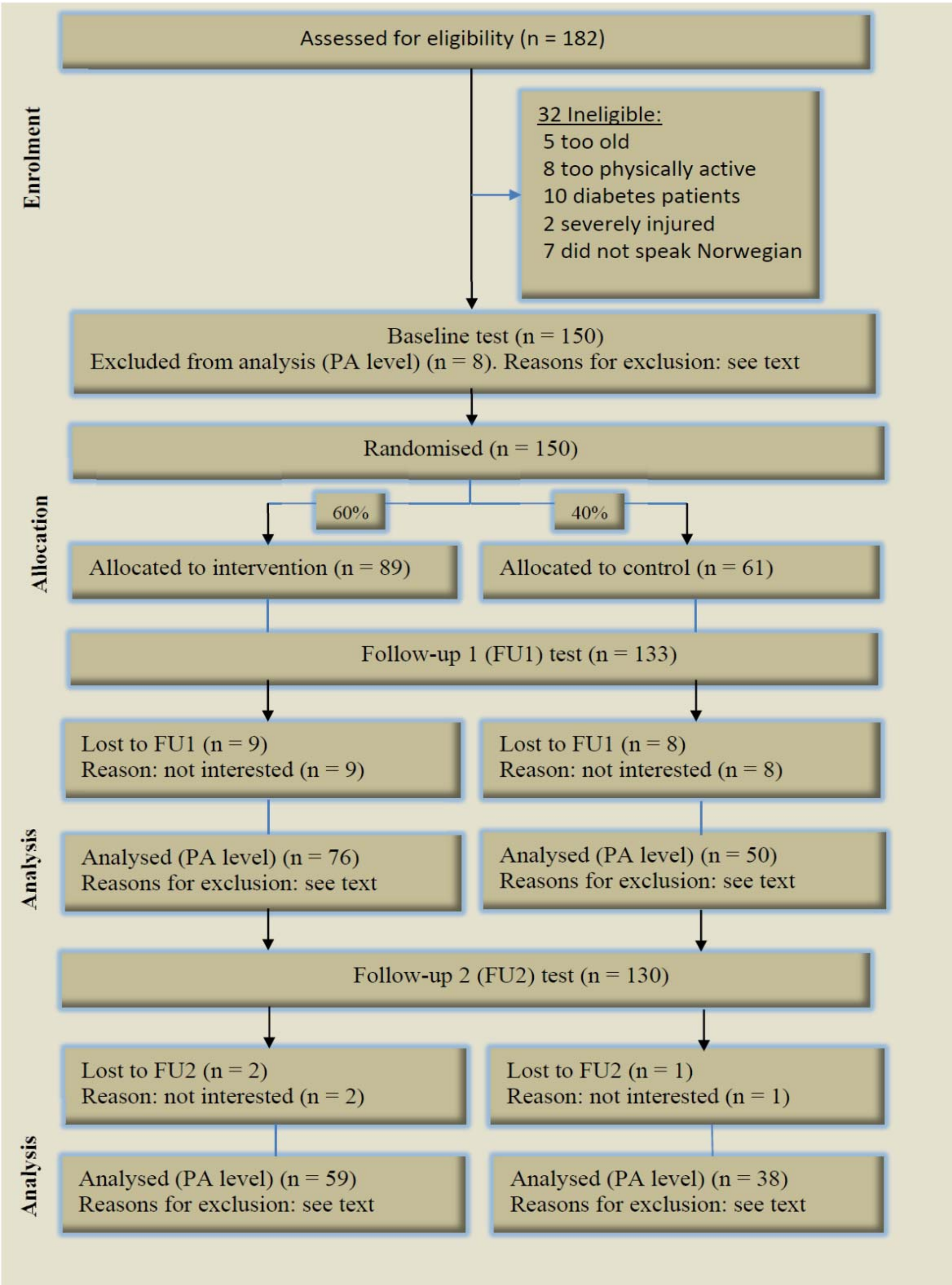


Figure: Flow of participants through the trial. FU1; follow up 1, FU2; follow-up 2.

Appendixes I-VIII

Appendix I

Questionnaire 1

Appendix I
Questionnaire 1

FAM studien

Spørreskjema
Del 1
- fysisk aktivitet og helse

Appendix I
Questionnaire 1

Kjære deltaker!

Hensikten med denne undersøkelsen er å kartlegge hvor fysisk aktiv du er og hvorfor du er fysisk aktiv eller ikke. Ved å besvare dette spørreskjemaet bidrar du til å få fram nyttig kunnskap uansett om du er fysisk aktiv eller ikke.

Informasjonen i dette spørreskjemaet behandles konfidensielt og ditt navn vil verken forekomme i datafiler eller skriftlig materiale.

Vennligst svar på spørsmålene så godt du kan. Hvis det er spørsmål du ikke ønsker å svare på kan de hoppes over. Spør oss hvis det er noe du lurer på. Ingen spørsmål er dumme! Spørreskjemaet tar omtrent 25 minutter å fylle ut.

Deltakernr.___________ Dato__________

Appendix I
Questionnaire 1

Bakgrunnsinformasjon

1. Fødselsår: 19 ☐ ☐

2a. Har du bodd hele ditt liv i Norge?

Ja ☐ Nei ☐

2b. Hvis nei, hvor gammel var du da du flyttet du til Norge:_____år

3. Hvilken utdanning er den høyeste du har fullført?
(Sett ett kryss)

☐ Mindre enn 7 år grunnskole
☐ Grunnskole 7-10 år
☐ Realskole, middelskole, yrkesskole, 1-2 årig videregående skole
☐ Artium, økonomisk gymnas, allmennfaglig retning i videregående skole
☐ Høgskole/universitet, mindre enn 3 år
☐ Høgskole/universitet, 3 år eller mer

4. Hva er din hovedaktivitet?
(Sett ett kryss)

☐ Yrkesaktiv heltid
☐ Yrkesaktiv deltid
☐ Arbeidsledig
☐ Hjemmeværende
☐ Trygdet
☐ Student/militærtjeneste

5. Yrke (sett ett kryss)

☐ Kontorjobb
☐ Restaurant/butikk
☐ Kommunikasjon/transport (drosje, buss, trikk, t-bane, tog)
☐ Undervisning (for eksempel lærer/lærerassistent)
☐ Helsesektoren (sykepleier, lege, hjelpepleier, bioingeniør)
☐ Renhold
☐ Håndverker (snekker, rørlegger, murer, maler osv)
☐ Salg og service
☐ Annet, hva:____

Appendix I
Questionnaire 1

6. Er arbeidet ditt så fysisk anstrengende at du ofte er sliten i kroppen etter en arbeidsdag?

☐ Ja, nesten alltid

☐ Ganske ofte

☐ Ganske sjelden

☐ Aldri, eller nesten aldri

7. Krever arbeidet ditt så mye konsentrasjon og oppmerksomhet at du ofte føler deg utslitt etter en arbeidsdag?

☐ Ja, nesten alltid

☐ Ganske ofte

☐ Ganske sjelden

☐ Aldri, eller nesten aldri

8. Hvor høy var husholdningens samlede inntekt siste år?
Ta med alle inntekter fra arbeid, trygder, sosialhjelp og lignende

☐ Under 125 000 kr	☐ 401 000-550 000 kr
☐ 125 000-200 000 kr	☐ 551 000-700 000 kr
☐ 201 000-300 000 kr	☐ 701 000 -850 000 kr
☐ 301 000-400 000 kr	☐ Over 850 000 kr
☐ Ønsker ikke svare	

9a. Bor du sammen med noen?

Ja ☐ Nei ☐

9b. Hvis ja, hvem (sett gjerne flere kryss):

☐ Ektefelle/samboer

☐ Kjernefamilie (kone/samboer og egne barn)

☐ Storfamilie (kjernefamilie pluss andre)

☐ Andre personer, 18år eller eldre. Antall_____

☐ Personer under 18år. Antall______

Egen helse

10. Hvordan vurderer du din egen helse sånn i alminnelighet?

☐ Meget god

☐ God

☐ Verken god eller dårlig

☐ Dårlig

☐ Meget dårlig

Appendix I
Questionnaire 1

11. Det neste spørsmålet handler om aktiviteter som du kanskje utfører i løpet av en vanlig dag. Er din helse slik at den begrenser deg i utførelsen av disse aktivitetene nå? Hvis ja, hvor mye?

(kryss av ett alternativ på hver linje)

	Ja, begrenser meg mye	Ja, begrenser meg litt	Nei, begrenser meg ikke i det hele tatt
a. Anstrengende aktiviteter som å løpe, løfte tunge gjenstander, delta i anstrengende idrett	☐	☐	☐
b. Moderate aktiviteter som å flytte et bord, støvsuge, gå en tur eller drive med hagearbeid	☐	☐	☐
c. Løfte eller bære en handlekurv	☐	☐	☐
d. Gå opp trappen flere etasjer	☐	☐	☐
e. Gå opp trappen en etasje	☐	☐	☐
f. Gå mer enn to kilometer	☐	☐	☐

12. Hvor ofte i løpet av de siste 4 ukene har du: **(kryss av ett alternative på hver linje)**

	Hele tiden	Nesten hele tiden	Mye av tiden	En del av tiden	Litt av tiden	Ikke i det hele tatt
a. Følt deg full av tiltakslyst	☐	☐	☐	☐	☐	☐
b. Følt deg veldig nervøs?	☐	☐	☐	☐	☐	☐
c. Vært så langt nede at ingenting har kunnet muntre deg opp?	☐	☐	☐	☐	☐	☐
d. Følt deg rolig og harmonisk?	☐	☐	☐	☐	☐	☐
e. Hatt mye overskudd?	☐	☐	☐	☐	☐	☐
f. Følt deg nedfor og trist?	☐	☐	☐	☐	☐	☐
g. Følt deg sliten?	☐	☐	☐	☐	☐	☐
h. Følt deg glad?	☐	☐	☐	☐	☐	☐
i. Følt deg trett?	☐	☐	☐	☐	☐	☐

Appendix I
Questionnaire 1

13. Har du, eller har hatt:

- ☐ Astma
- ☐ Kronisk bronkitt/emfysem/KOLS
- ☐ Hjerteinfarkt
- ☐ Angina Pectoris (hjertekrampe)
- ☐ Hjerneslag/hjerneblødning (”drypp”)
- ☐ Kreft
- ☐ Allergi
- ☐ Psykiske plager du har søkt hjelp for
- ☐ Sukkersyke (diabetes type I)
- ☐ Sukkersyke (diabetes type II)
- ☐ Benskjørhet/osteoporose
- ☐ Revmatiske lidelser
- ☐ Annet, hva:____

14a. Tar du medisiner regelmessig?

Ja ☐ Nei ☐

14b. Hvis ja, hvilke medisiner tar du?

____

____

____

Sykdom i familien

15a. Har noen av dine familiemedlemmer fått diabetes (sukkersyke)?

Ja ☐ Nei ☐

15b. Hvis Ja, hvem:

- ☐ Mor
- ☐ Far
- ☐ Bror
- ☐ Søster
- ☐ Barn
- ☐ Besteforeldre
- ☐ Tante/onkel
- ☐ Søskenbarn

Røykevaner

16. Har du røykt/røyker du daglig?

- ☐ Ja, nå
- ☐ Ja, tidligere
- ☐ Aldri

Appendix I
Questionnaire 1

Fysisk aktivitet

De neste spørsmålene handler om fysisk aktivitet. Fysisk aktivitet omfatter både:

- **fysisk aktivitet i hverdagen (i arbeid, fritid og hjemme, samt hvordan du forflytter deg til og fra arbeid og fritidssysler)**
- **planlagte aktiviteter (gå på tur, fotball, cricket, tennis, dansing)**
- **trening (for å bedre fysisk form, muskelstyrke, kondisjon og andre ferdigheter)**

17. Tenk på de siste 6 måneder, hvilke av følgende aktiviteter har du drevet med:

☐ Landhockey/innebandy/skøyter/bandy/hockey

☐ Cricket ☐ Svømming

☐ Treningsstudio (styrketrening, utholdenhetsapparater)

☐ Turgåing ☐ Ballspill

☐ Dans ☐ Sykling/spinning

☐ Langrenn ☐ Badminton/Tennis/Squash

☐ Alpint/snowboard ☐ Bordtennis

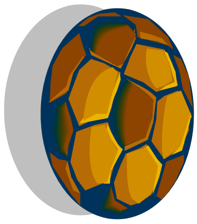
☐ Trening til musikk i sal ☐ Golf

☐ Stavgang ☐ Vanngymnastikk

☐ Kampsport (karate, judo, boksing) ☐ Padling/roing

☐ Yoga/pilates ☐ Jogging

☐ Annet, hva:______________________________________



18. Angi bevegelse og kroppslig anstrengelse i din fritid. Hvis aktiviteten varierer meget f.eks mellom sommer og vinter, så ta et gjennomsnitt. Spørsmålet gjelder bare det siste året (sett ett kryss i den ruta som passer best)

Lese, ser på fjernsyn eller annen stillesittende beskjeftigelse?	☐
Spaserer, sykler eller beveger deg på annen måte minst 4 timer i uka? (Her skal du regne med gang eller sykling til arbeidsstedet, søndagsturer m.m)	☐
Driver mosjonsidrett, tyngre hagearbeid e.l? (Merk at aktiviteten skal vare minst 4 timer i uka)	☐
Trener hardt eller driver konkurranseidrett regelmessig og flere ganger i uka	☐

Appendix I
Questionnaire 1

Når du svarer på spørsmålene 19-20:

Meget anstrengende – er fysisk aktivitet som får deg til å puste *mye mer* enn vanlig

Middels anstrengende – er fysisk aktivitet som får deg til å puste *litt mer* enn vanlig

Det er kun aktiviteter som varer *minst 10 minutter i strekk* som skal rapporteres.

19a. Hvor mange dager i løpet av de siste 7 dager har du drevet med *meget anstrengende* fysiske aktiviteter som tunge løft, gravearbeid, aerobics eller sykle fort? Tenk bare på aktiviteter som varer *minst 10 minutter i strekk*.

☐ Dager per uke

☐ Ingen (gå til spørsmål 20a)

19b. På en vanlig dag hvor du utførte *meget anstrengende* fysiske aktiviteter, hvor lang tid brukte du da på dette?

☐ ☐ Timer ☐ ☐ Minutter ☐ Vet ikke/husker ikke

20a. Hvor mange dager i løpet av de siste 7 dager har du drevet med *middels anstrengende* fysiske aktiviteter som å bære lette ting, sykle i moderat tempo eller mosjonstennis? Ikke ta med gange.

☐ Dager per uke

☐ Ingen (gå til spørsmål 21a)

20b. På en vanlig dag hvor du utførte *middels anstrengende* fysiske aktiviteter, hvor lang tid brukte du da på dette?

☐ ☐ Timer ☐ ☐ Minutter ☐ Vet ikke/husker ikke

21a. Hvor mange dager i løpet av de siste 7 dager, *gikk du minst 10 minutter* i strekk for å komme deg fra ett sted til et annet? Dette inkluderer gange på jobb og hjemme, gange til buss, eller gange som du gjør på tur eller som trening i fritiden.

☐ Dager per uke

☐ Ingen (gå til spørsmål 22a)

21b. På en vanlig dag hvor du *gikk* for å komme deg fra et sted til et annet, hvor lang tid brukte du da totalt på å gå?

☐ ☐ Timer ☐ ☐ Minutter ☐ Vet ikke/husker ikke

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21c. Når du forflytter deg fra et sted til et annet ved å gå, i hvilket tempo går du vanligvis?

☐ I raskt tempo ☐ I middels tempo ☐ I langsomt tempo

22a. Hender det at du bruker sykkel i løpet av en vanlig uke?

☐ Ja ☐ Nei

Hvis nei gå til spørsmål nummer 23.

22b. Hvor mange dager i *en vanlig uke* sykler du *minst 10 minutter i strekk* for å komme fra et sted til ett annet?

Om sommeren

☐ Dager per uke

Om vinteren

☐ Dager per uke

22c. På *en vanlig dag* hvor du *sykler* for å komme deg fra et sted til ett annet, hvor lang tid bruker du da totalt på å sykle?

Om sommeren

☐☐ Timer ☐☐ Minutter

Om vinteren

☐☐ Timer ☐☐ Minutter

22d. Når du forflytter deg fra ett sted til ett annet på sykkel, i hvilket tempo sykler du vanligvis?

☐ I raskt tempo ☐ I middels tempo ☐ I langsomt tempo

De neste to spørsmålene handler om dine vaner knyttet til bruk av TV og PC utenom jobb

23. Utenom jobb: Hvor mange timer ser du vanligvis på TV og sitter med PC på en hverdag?

☐ Mindre enn 1 time ☐ 1-2 timer
☐ 2-3 timer ☐ 3-4 timer
☐ 4-5 timer ☐ Mer enn 5 timer

24. Utenom jobb: Hvor mange timer ser du vanligvis på TV og sitter med PC på en helgedag?

☐ Mindre enn 1 time ☐ 1-2 timer
☐ 2-3 timer ☐ 3-4 timer
☐ 4-5 timer ☐ Mer enn 5 timer

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Holdninger til fysisk aktivitet

De neste spørsmålene handler om dine holdninger til fysisk aktivitet. Dersom du ikke prøver å være fysisk aktiv, kan det være at noen av spørsmålene ikke passer for deg. Vennligst les og svar på alle spørsmålene likevel.

25. Nedenfor følger en rekke grunner for å drive med fysisk aktivitet. Vennligst sett ett eller flere kryss for den (de) grunnen(e) som er viktige for deg.

☐ Forebygge helseplager
☐ Holde vekten nede
☐ For å se veltrent ut
☐ Øke prestasjonsevnen
☐ Gjøre fritiden trivelig
☐ For å ha det gøy
☐ Føler jeg må
☐ Komme i bedre form
☐ Anbefalt av lege, fysioterapeut eller liknende
☐ Fysisk og psykisk velvære
☐ For å treffe og omgås andre mennesker
☐ Oppbygging etter sykdom/skade
☐ Oppleve spenning/utfordring
☐ For å få frisk luft

Hvis andre grunner, hvilke:____

26. Tenk deg alle former for fysisk aktivitet. Ta stilling til påstanden: Jeg er sikker på at jeg kan gjennomføre planlagt fysisk aktivitet selv om:

	Ikke i det hele tatt 1	2	3	4	5	Veldig sikker 6	7
a. Jeg er trett	☐	☐	☐	☐	☐	☐	☐
b. Jeg føler meg nedtrykt	☐	☐	☐	☐	☐	☐	☐
c. Jeg er bekymret	☐	☐	☐	☐	☐	☐	☐
d. Jeg er sint på grunn av noe	☐	☐	☐	☐	☐	☐	☐
e. Jeg føler meg stresset	☐	☐	☐	☐	☐	☐	☐
f. Været er dårlig	☐	☐	☐	☐	☐	☐	☐
g. Jeg har mye å gjøre/liten tid	☐	☐	☐	☐	☐	☐	☐

27. Tenk på alle former for fysisk aktivitet. For hver påstand, angi i hvilken grad du er enig/uenig. *For hver påstand, sett ett kryss*

	Helt enig 1	2	3	4	5	6	Helt uenig 7
a. Om jeg er regelmessig fysisk aktiv eller ikke er helt opp til meg	☐	☐	☐	☐	☐	☐	☐
b. Hvis jeg ville, hadde jeg ikke hatt noen problemer med å være regelmessig fysisk aktiv	☐	☐	☐	☐	☐	☐	☐
c. Jeg ville likt å være regelmessig aktiv, men jeg vet ikke riktig om jeg kan	☐	☐	☐	☐	☐	☐	☐
d. Jeg har full kontroll over å være regelmessig fysisk aktiv	☐	☐	☐	☐	☐	☐	☐
e. Å være regelmessig fysisk aktiv er vanskelig for meg	☐	☐	☐	☐	☐	☐	☐

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28. I hvilken grad beskriver disse påstandene deg som person?

	Passer dårlig 1	2	3	4	Passer bra 5
a. Jeg ser på meg selv som en person som er opptatt av fysisk aktivitet	☐	☐	☐	☐	☐
b. Jeg tenker på meg selv som en person som er opptatt av å holde seg i god fysisk form	☐	☐	☐	☐	☐
c. Å være fysisk aktiv er en stor del av hvem jeg er	☐	☐	☐	☐	☐

29. I hvilken utstrekning mener du at daglig fysisk aktivitet kan ha gunstig effekt for å forebygge følgende sykdommer:

	Stor effekt	**Liten effekt**	**Ingen effekt**	**Vet ikke**
Hjerte- og karsykdom	☐	☐	☐	☐
Muskel-skjelettlidelser	☐	☐	☐	☐
Diabetes type 2	☐	☐	☐	☐
Kreft	☐	☐	☐	☐
Høyt blodtrykk	☐	☐	☐	☐
Psykiske lidelser	☐	☐	☐	☐
Overvekt og fedme	☐	☐	☐	☐
Mage-/tarmsykdommer	☐	☐	☐	☐
Astma og allergi	☐	☐	☐	☐
KOLS	☐	☐	☐	☐

30. Her har skalaen 5 punkter fra ”Ingen” til ”Alle”

Av folk du kjenner godt – hvor mange er fysisk aktive minst 3 ganger i uka?	☐ Ingen	☐ Noen få	☐ En god del	☐ De aller fleste	☐ Alle

31. Her har skalaen 4 punkter fra ”Helt uenig” til ”Helt enig”
Tenk på deg selv nå for tiden. Folk som er viktige for meg:

a. Synes jeg bør være fysisk aktiv	☐ Helt uenig	☐ Litt uenig	☐ Litt enig	☐ Helt enig
b. Synes det er bra om jeg er fysisk aktiv	☐ Helt uenig	☐ Litt uenig	☐ Litt enig	☐ Helt enig
c. Vil at jeg skal være fysisk aktiv	☐ Helt uenig	☐ Litt uenig	☐ Litt enig	☐ Helt enig
d. Synes det er upassende at jeg er fysisk aktiv	☐ Helt uenig	☐ Litt uenig	☐ Litt enig	☐ Helt enig
e. Liker ikke at jeg er fysisk aktiv	☐ Helt uenig	☐ Litt uenig	☐ Litt enig	☐ Helt enig

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Questionnaire 1

32. Har familien din (medlemmer i husstanden):

	Aldri	Sjelden	Noen få ganger	Ofte	Veldig ofte	Passer ikke
a. Oppmuntret deg til å være fysisk aktiv	☐	☐	☐	☐	☐	☐
b. Diskutert fysisk aktivitet sammen med deg	☐	☐	☐	☐	☐	☐
c. Forandret planene sine slik at dere kunne drive fysisk aktivitet sammen	☐	☐	☐	☐	☐	☐
d. Overtatt oppgaver for deg, slik at du fikk mer tid til å være fysisk aktiv	☐	☐	☐	☐	☐	☐
e. Sagt at fysisk aktivitet vil være bra for helsen din	☐	☐	☐	☐	☐	☐
f. Snakket om hvor godt de liker å være fysisk aktive	☐	☐	☐	☐	☐	☐

33. Har vennene dine/bekjente/familiemedlemmer utenfor husstanden:

	Aldri	Sjelden	Noen få ganger	Ofte	Veldig ofte	Passer ikke
a. Foreslått at dere skulle drive fysisk aktivitet sammen	☐	☐	☐	☐	☐	☐
b. Oppmuntret deg til å være fysisk aktiv	☐	☐	☐	☐	☐	☐
c. Gitt deg hjelpsomme påminnelser om fysisk aktivitet som: "Skal du mosjonere i kveld?"	☐	☐	☐	☐	☐	☐
d. Forandret planene sine slik at dere kunne drive fysisk aktivitet sammen	☐	☐	☐	☐	☐	☐
e. Sagt at fysisk aktivitet vil være bra for helsen din	☐	☐	☐	☐	☐	☐
f. Snakket om hvor godt de liker å være fysisk aktive	☐	☐	☐	☐	☐	☐

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34. Ta stilling til påstanden: "At jeg er regelmessig fysisk aktiv i løpet av <u>den neste måneden</u> vil være...:" Sett kryss i den ruta som samsvarer med din oppfatning. Tenk på alle former for fysisk aktivitet

		1	2	3	4	5	6	7	
a.	Dumt	☐	☐	☐	☐	☐	☐	☐	Klokt
b.	Skadelig	☐	☐	☐	☐	☐	☐	☐	Verdifullt
c.	Unyttig	☐	☐	☐	☐	☐	☐	☐	Nyttig
d.	Galt	☐	☐	☐	☐	☐	☐	☐	Riktig
e.	Brysomt	☐	☐	☐	☐	☐	☐	☐	Lettvint
f.	Ubehagelig	☐	☐	☐	☐	☐	☐	☐	Behagelig
g.	Ille	☐	☐	☐	☐	☐	☐	☐	Bra
h.	Kjedelig	☐	☐	☐	☐	☐	☐	☐	Interessant

35. Ta stilling til påstanden: "Hvis jeg er fysisk aktiv regelmessig i løpet av <u>den neste måneden</u>….." Sett kryss i den ruta som samsvarer med din oppfatning. Tenk på alle former for fysisk aktivitet:

Usannsynlig → Høyst sannsynlig

		1	**2**	**3**	**4**	**5**	**6**	**7**
a.	Vil jeg komme i bedre form	☐	☐	☐	☐	☐	☐	☐
b.	Vil jeg føle meg bedre	☐	☐	☐	☐	☐	☐	☐
c.	Vil jeg få mer overskudd	☐	☐	☐	☐	☐	☐	☐
d.	Vil det løse opp spenninger og stress i kroppen	☐	☐	☐	☐	☐	☐	☐
e.	Vil jeg komme i bedre humør	☐	☐	☐	☐	☐	☐	☐
f.	Vil jeg gå ned i vekt	☐	☐	☐	☐	☐	☐	☐
g.	Vil jeg få mindre tid til andre ting	☐	☐	☐	☐	☐	☐	☐
h.	Vil det koste meg mye penger	☐	☐	☐	☐	☐	☐	☐
i.	Kan jeg pådra meg skader	☐	☐	☐	☐	☐	☐	☐

Appendix I
Questionnaire 1

36. Nedenfor følger en rekke ting som noen oppgir som hindring for å være fysisk aktiv. Ranger hvor stor de enkelte er en hindring for deg.

	Ikke aktuell 0	1	2	3	4	Veldig aktuell 5
a. Lite tid	☐	☐	☐	☐	☐	☐
b. Ikke den sporty typen	☐	☐	☐	☐	☐	☐
c. For dårlig form	☐	☐	☐	☐	☐	☐
d. Dårlig vær	☐	☐	☐	☐	☐	☐
e. Liten motivasjon	☐	☐	☐	☐	☐	☐
f. For dyrt	☐	☐	☐	☐	☐	☐
g. Føler med nedtrykt	☐	☐	☐	☐	☐	☐
h. Bekymringer	☐	☐	☐	☐	☐	☐
i. Stress	☐	☐	☐	☐	☐	☐
j. Vil heller drive med andre ting	☐	☐	☐	☐	☐	☐
k. Mangel på lokaler/uteområde	☐	☐	☐	☐	☐	☐
l. Vet ikke hvordan	☐	☐	☐	☐	☐	☐
m. Ingen å drive aktivitet sammen med	☐	☐	☐	☐	☐	☐
n. Finner ikke aktiviteter som er ok å drive med	☐	☐	☐	☐	☐	☐
o. Dårlig helse	☐	☐	☐	☐	☐	☐

Annet____

37. Er det i ditt nærmiljø:

	Helt uenig	Litt uenig	Litt enig	Helt enig
a. Trygge steder å gå (park/friområde, turvei, fortau) som er tilstrekkelig opplyst	☐	☐	☐	☐
b. Mange steder der du kan være fysisk aktiv (utendørs, svømmehall etc.)	☐	☐	☐	☐
c. Flere tilrettelagte tilbud om trening og fysisk aktivitet (som kunne være aktuelle for deg)	☐	☐	☐	☐
d. Greit å gå til butikker (10-15 min å gå, fortau langs de fleste veiene)	☐	☐	☐	☐
e. Lett tilgang til gang- eller sykkelveier	☐	☐	☐	☐
f. Så mye trafikk i gatene at det er vanskelig eller lite hyggelig å gå	☐	☐	☐	☐
g. Fotgjengeroverganger og lyssignal som gjør det enklere å krysse veien	☐	☐	☐	☐

Appendix I
Questionnaire 1

38. Her lurer vi på hvorfor du er fysisk aktiv. Se på påstandene nedenfor, og ring rundt det alternativet som passer best for deg. Benytt følgende skala:

Ikke sant for meg		Delvis sant		Veldig sant
1	2	3	4	5

Jeg er fysisk aktiv fordi:					
a. Det er viktig for meg……………………………………………	1	2	3	4	5
b. Jeg føler meg skamfull når jeg ikke er fysisk aktiv………..	1	2	3	4	5
c. Det er av stor betydning for meg personlig…………………	1	2	3	4	5
d. Andre sier at jeg skal gjøre det………………………………	1	2	3	4	5
e. Jeg setter pris på det…………………………………………	1	2	3	4	5
f. Det er forventet av meg………………………………………	1	2	3	4	5
g. Fordelene med å trene betyr mye for meg…………………	1	2	3	4	5
h. Det er gøy……………………………………………………	1	2	3	4	5
i. Jeg føler et press fra andre til å være fysisk aktiv………..	1	2	3	4	5
j. Jeg liker å bevege meg………………………………….…	1	2	3	4	5
g. Jeg føler meg skyldig hvis jeg ikke er fysisk aktiv………	1	2	3	4	5
h. Det er interessant for meg………………………………	1	2	3	4	5
i. Min ektefelle/venner/familie sier at jeg skal gjøre det…..	1	2	3	4	5
j. Jeg har glede av å være i aktivitet………………………..	1	2	3	4	5
k. Jeg føler meg mislykket om jeg ikke er fysisk aktiv…….	1	2	3	4	5
l. Andre ikke skal bli skuffet over meg…………………….	1	2	3	4	5
m. Jeg blir glad og tilfreds av å trene……………………….	1	2	3	4	5
n. Det er viktig for meg å trene regelmessig………………..	1	2	3	4	5

Andre grunner:____

Søvn

39) Hvor mange timer i døgnet sover du vanligvis på hverdager?

- ☐ Mindre enn 3 timer
- ☐ 8 - 10 timer
- ☐ 3 - 5 timer
- ☐ 10 timer eller mer
- ☐ 5 - 8 timer

40) Hvor mange timer i døgnet sover du vanligvis på helgedager eller fridager?

- ☐ Mindre enn 3 timer
- ☐ 8 - 10 timer
- ☐ 3 - 5 timer
- ☐ 10 timer eller mer
- ☐ 5 - 8 timer

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Questionnaire 1

Tusen takk for innsatsen så langt, nå gjenstår kun del 2, som går på kost!

Appendix II
Questionnaire 2

FAM studien

Spørreskjema
Del 2
- Kost

Appendix II

Questionnaire 2

Appendix II
Questionnaire 2

Kjære deltaker!

Hensikten med denne delen er å kartlegge kosten din.

Informasjonen i dette spørreskjemaet behandles konfidensielt og ditt navn vil verken forekomme i datafiler eller skriftlig materiale.

Vennligst svar på spørsmålene så godt du kan. Hvis det er spørsmål du ikke ønsker å svare på kan de hoppes over. Spør oss hvis du lurer på noe. Ingen spørsmål er dumme! Spørreskjemaet tar omtrent 25 minutter å fylle ut.

Deltakernr.___________ Dato__________

Appendix II
Questionnaire 2

Drikke/yoghurt

1. Tenk tilbake på de siste 14 dager. Hvor ofte har du drukket følgende drikker og hvor mye har du drukket per. gang?
Kryss av (x) for hvor ofte og hvor mye per. gang der det er aktuelt.
Eksempel: har du drukket coladrikker med sukker disse dagene? Hvis ja, hvor ofte har du drukket slike drikker? Og hvor mye per. gang der det er aktuelt?

	Frekvens						Mengde			
	Ikke drukket	< 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	Daglig	1/5 l	1/3 l	½ l	1+ l
Coladrikk med sukker	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Annen brus med sukker	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Coladrikk kunstig søtet	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Annen brus kunstig søtet	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Saft og andre drikker med sukker	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Saft andre drikker, kunstig søtet	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Fruktjuice	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
H-melk, kefir, kulturmelk	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lettmelk, cultura, biola, sjokomelk	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ekstra lettmelk	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Skummet melk, skummet kultur	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Te	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Filter kaffe	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Kokekaffe	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Annen kaffe	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Annen drikke	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Appendix II
Questionnaire 2

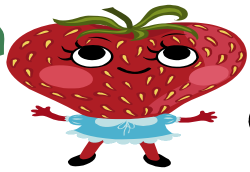
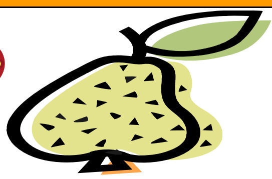
2. Hvis du drikker te eller kaffe, hvor mange teskjeer sukker og/eller honning bruker du?

	Bruker ikke sukker/honning	1ts	2ts	3ts	4ts	≥5 ts
Antall teskjeer sukker/honning i te	☐	☐	☐	☐	☐	☐
Antall teskjeer sukker i kaffe	☐	☐	☐	☐	☐	☐

3. Tenk tilbake på de siste 14 dager. Hvor ofte har du spist yoghurt (fra beger, til frokostblandinger og/eller i matlaging)?

	Ikke spist	< 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	Daglig
Yoghurt naturell	☐	☐	☐	☐	☐	☐
Gresk/tyrkisk yoghurt	☐	☐	☐	☐	☐	☐
Yoghurt med frukt/bær	☐	☐	☐	☐	☐	☐
Lett yoghurt med frukt/bær	☐	☐	☐	☐	☐	☐

Frukt


4. Tenk tilbake på de siste 14 dager. Hvor ofte har du spist frukt og/eller bær?

	Aldri eller < 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	1 g/dag	2 g/dag	≥ 3 g/dag
Frisk frukt, bær, fruktsalat/fruktchaart el.l.	☐	☐	☐	☐	☐	☐	☐

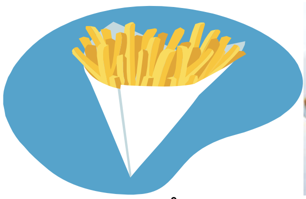
Appendix II
Questionnaire 2

Grønnsaker

5. Tenk tilbake på de siste 14 dager. Hvor ofte har du spist grønnsaker?

	Aldri eller < 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	1 g/dag	2 g/dag	≥ 3 g/dag
Rå grønnsaker, blandede grønnsaker/grønnsakschaart, salater	☐	☐	☐	☐	☐	☐	☐
Stekte/wokkede grønnsaker, kokte/dampede/ovnsbakte grønnsaker, grønnsaker i gryte (for eksempel curry, salen)	☐	☐	☐	☐	☐	☐	☐

Potet



6. Tenk tilbake på de siste 14 dager. Hvor ofte har du spist potet?

	Aldri eller < 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	1 g/dag	2 g/dag	≥ 3 g/dag
Potet (kokt, bakt, stekt i ovn)	☐	☐	☐	☐	☐	☐	☐
Gratinerte poteter	☐	☐	☐	☐	☐	☐	☐
Pommes frites (frityr, gatekjøkken	☐	☐	☐	☐	☐	☐	☐

Appendix II
Questionnaire 2

Bønner, linser, erter, kikerter og lignende

7. Tenk tilbake på de siste 14 dager. Hvor ofte har du spist bønner, linser, erter, kikerter eller lignende?

	Aldri eller < 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	1 g/dag	2 g/dag	≥ 3 g/dag
Tomatbønner, andre bønner, erte-/bønnestuing, dahl, linse/ertesuppe, chaart med kikerter, linsekaker, falafel (o.l.), hummus	☐	☐	☐	☐	☐	☐	☐
Annet________________________	☐	☐	☐	☐	☐	☐	☐

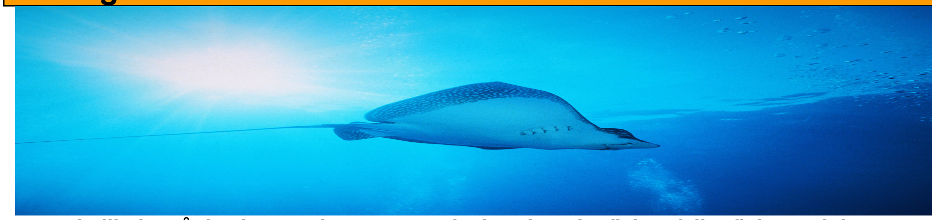
Kjøtt (rødt og hvitt kjøtt) og farsemat

8. Tenk tilbake på de siste 14 dager. Hvor ofte har du spist kjøtt og/eller farseprodukter til lunsj, middag og/eller andre måltider? (ikke regn med pålegg på brødskive)

	Ikke spist	< 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	Daglig
Kylling, kalkun, annet magert kjøtt som renskåret oksekjøtt, svinekjøtt (stekt, kokt, grillet, i gryte etc)	☐	☐	☐	☐	☐	☐
Retter med karbonadedeig, hamburger, pølse/farsemat av kylling/kalkun, lettpølser	☐	☐	☐	☐	☐	☐
Pølser, kjøttkaker, kebab, andre retter med kjøttdeig/andre farseprodukter av kjøtt	☐	☐	☐	☐	☐	☐
Pizza, ”fastfood (kjøpt utenfor hjemmet)	☐	☐	☐	☐	☐	☐
Annet____________________________________	☐	☐	☐	☐	☐	☐

Appendix II
Questionnaire 2

Fisk og fiskemat



9. Tenk tilbake på de siste 14 dager. Hvor ofte har du spist fisk og/eller fiskeprodukter?

	Ikke spist	< 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	Daglig
Mager fisk (fileter, hele stykker) av torsk, sei, flyndre, kolje, tunfisk, annen mager fisk (stekt, dampet, kokt, grillet, etc)	☐	☐	☐	☐	☐	☐
Fet fisk som laks, ørret, kveite/hellefisk, makrell, sild, annen fet fisk (stekt, dampet, kokt, grillet etc)	☐	☐	☐	☐	☐	☐
Fiskeprodukter (fiskekaker, fiskepudding el.l.)	☐	☐	☐	☐	☐	☐
Fiskepinner eller tilsvarende produkter (frityrstekt eller stekt)	☐	☐	☐	☐	☐	☐
Annet___________________________________	☐	☐	☐	☐	☐	☐

Tilberedning av mat

10. Tenk tilbake på de siste 14 dager. Hvor ofte har du spist mat som er blitt:

	Ikke spist	< 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	Daglig
Stekt i panne (m/smør, margarin, olje, og lignende), laget i wok/haandi	☐	☐	☐	☐	☐	☐
Frityrstekt/deep-fry	☐	☐	☐	☐	☐	☐

Appendix II
Questionnaire 2

Type fett (smør, margariner, oljer, og annet) brukt på brød el.l., til matlaging/tilberedning av mat

11. Tenk tilbake på de siste 14 dager.
- Hva slags type fett har du brukt på brødmat?
- Hva slags type fett har du brukt til steking?
- Hva slags type fett har du brukt til fritering/deep-fry?
- Hva slags type fett har du brukt til annen matlaging som baking?

	På brødmat	Til steking	Til frityr/ deep-fry	Til annen matlaging
Ingen bruk av fett	☐	☐	☐	☐
Smør (meierismør)	☐	☐	☐	☐
Melange, bremyk	☐	☐	☐	☐
Brelett	☐	☐	☐	☐
Myk margarin (soft flora, soft ekstra, soft oliven, vita, soya, o.l)	☐	☐	☐	☐
Plantemargarin lett (soft light, vita lett, o.l), ProVita/ProActiv (Becel)	☐	☐	☐	☐
Flytende margarin (melange, olivero, vita, bremyk)	☐	☐	☐	☐
Vegetabilske oljer (solsikke-/maisolje, soyaolje, olivenolje, rapsolje e.l)	☐	☐	☐	☐
Kokos/palmeolje	☐	☐	☐	☐
Annen margarin	☐	☐	☐	☐
Annen olje	☐	☐	☐	☐
Ghee/nej/klaret smør	☐	☐	☐	☐

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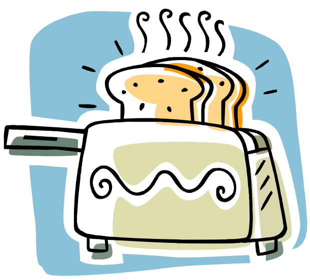
Questionnaire 2

Brød, kornvarer, pasta og ris

12. Tenk tilbake på de siste 14 dager. Hvor ofte har du spist følgende matvarer?

	Ikke spist	< 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	Daglig
Fint brød (loff, nan, frokostknekkebrød, el.l) og/eller halvgrovt brød (kneipp brød/rundstykke/knekkebrød)	☐	☐	☐	☐	☐	☐
Grovt og ekstra grovt brød/rundstykke/knekkebrød, chapati	☐	☐	☐	☐	☐	☐
Frokostblandinger/müsli med ingen eller litt tilsatt sukker (havregryn, firkorn, el.l)	☐	☐	☐	☐	☐	☐
Frokostblandinger/ müsli med mye sukker	☐	☐	☐	☐	☐	☐
Vanlig ris, makaroni, pasta/spagetti, coscous	☐	☐	☐	☐	☐	☐
Fullkornpasta eller naturris/upolert ris/fullkorn ris, hirse	☐	☐	☐	☐	☐	☐



Appendix II
Questionnaire 2

Pålegg

13. Tenk tilbake på de siste 14 dager. Hvor ofte har du brukt følgende pålegg?

	Ikke spist	< 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	Daglig
Hvitost (norvegia, gulost, nøkkelost, smøreost), brunost, andre fete oster	☐	☐	☐	☐	☐	☐
Lettere/mager hvitost/smøreost, lettere brunost, prim, andre lettere/magre oster	☐	☐	☐	☐	☐	☐
Leverpostei, salami, servelat, fårepølse etc.	☐	☐	☐	☐	☐	☐
Leverpostei med mindre fett, leverpostei med "sunt" fett, kokt skinke, kalkunpålegg, lett servelat	☐	☐	☐	☐	☐	☐
Fiskepålegg (makrell i tomat, annen makrell, laks, ørret, sardiner, ansjos, sild, kaviar)	☐	☐	☐	☐	☐	☐
Syltetøy, marmelade	☐	☐	☐	☐	☐	☐
Lett syltetøy	☐	☐	☐	☐	☐	☐
Sjokolade-, nøttepålegg, sunda, sirup, honning el.l	☐	☐	☐	☐	☐	☐
Majonessalater (italiensk salat, rekesalat, el.l)	☐	☐	☐	☐	☐	☐
Egg	☐	☐	☐	☐	☐	☐
Annet________________________________	☐	☐	☐	☐	☐	☐

Appendix II
Questionnaire 2

Søte matvarer

14. Tenk tilbake på de siste 14 dager. Hvor ofte har du spist følgende matvarer?

	Ikke spist	< 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	Daglig
Kaker, formkake, muffins, smultring, wienerbrød/-stang	☐	☐	☐	☐	☐	☐
Søt kjeks (fylte kjeks, sjokoladekjeks: balerina, bixit, vaffelkjeks, mariekjeks, kornmo, o.l)	☐	☐	☐	☐	☐	☐
Bolle, skolebrød, annen søt gjærbakst	☐	☐	☐	☐	☐	☐
Vafler, sveler, lapper, o.l	☐	☐	☐	☐	☐	☐
Sjokolade/ smågodt/drops, snacks med sukker (gele, Turkish delight)	☐	☐	☐	☐	☐	☐
Utenlandske søt snacks (mithai, jalebi, halwa, zarda, la`du, baklava o.l)	☐	☐	☐	☐	☐	☐
Iskrem	☐	☐	☐	☐	☐	☐
Desserter/pudding/riskrem	☐	☐	☐	☐	☐	☐
Tørket frukt	☐	☐	☐	☐	☐	☐
Andre søte matvarer/snacks	☐	☐	☐	☐	☐	☐

Snacks

15. Tenk tilbake på de siste 14 dager. Hvor ofte har du spist følgende matvarer?

	Ikke spist	< 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	Daglig
Salt snacks (vanlig chips/potetgull med div smaker, tortillachips), andre fete snacks, bombay, mix o.l)	☐	☐	☐	☐	☐	☐
"Lett" snacks (skruer, saltstenger, popcorn)	☐	☐	☐	☐	☐	☐
Nøtter	☐	☐	☐	☐	☐	☐

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Questionnaire 2

Måltidsfrekvens

16. Hvor ofte pleier du å spise følgende måltider i løpet av en uke?
(Sett ett kryss for hvert måltid)

	Aldri/sjeldent	1 gang i uken	2 ganger i uken	3 ganger i uken	4 ganger i uken	5 ganger i uken	6 ganger i uken	Hver dag
Frokost	☐	☐	☐	☐	☐	☐	☐	☐
Lunsj	☐	☐	☐	☐	☐	☐	☐	☐
Middag	☐	☐	☐	☐	☐	☐	☐	☐
Kveldsmat	☐	☐	☐	☐	☐	☐	☐	☐

Tusen takk for innsatsen!

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NORGES IDRETTSHØGSKOLE

FAM studien

Spørreskjema

- fysisk aktivitet og helse

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Questionnaire 3

Kjære deltaker!

Hensikten med denne undersøkelsen er å kartlegge hvor fysisk aktiv du er og hvorfor du er fysisk aktiv eller ikke. Ved å besvare dette spørreskjemaet bidrar du til å få fram nyttig kunnskap uansett om du er fysisk aktiv eller ikke.

Informasjonen i dette spørreskjemaet behandles konfidensielt og ditt navn vil verken forekomme i datafiler eller skriftlig materiale.

Vennligst svar på spørsmålene så godt du kan. Hvis det er spørsmål du ikke ønsker å svare på kan de hoppes over.

Takk for all god innsats!

Vennlig hilsen
Eivind

Deltakernr.___________ Dato__________

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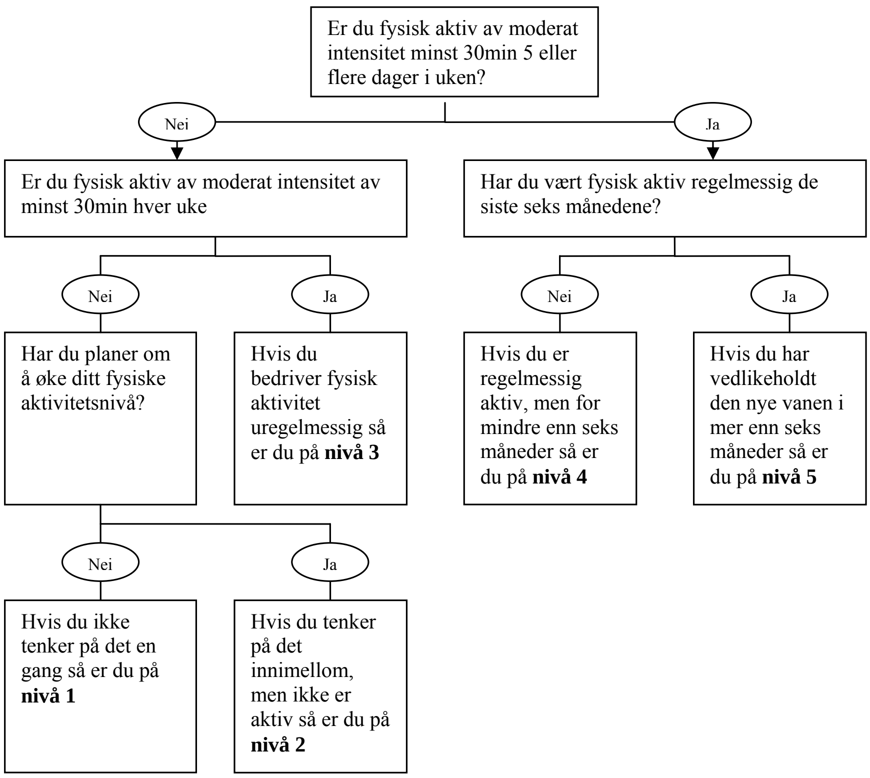
Questionnaire 3

Les igjennom og kryss av på det nivået du føler er riktig for deg



Nivået mitt:__________

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Questionnaire 3

Arbeid

1. Er arbeidet ditt så fysisk anstrengende at du ofte er sliten i kroppen etter en arbeidsdag?

- ☐ Ja, nesten alltid
- ☐ Ganske ofte
- ☐ Ganske sjelden
- ☐ Aldri, eller nesten aldri

2. Krever arbeidet ditt så mye konsentrasjon og oppmerksomhet at du ofte føler deg utslitt etter en arbeidsdag?

- ☐ Ja, nesten alltid
- ☐ Ganske ofte
- ☐ Ganske sjelden
- ☐ Aldri, eller nesten aldri

Egen helse

3. Hvordan vurderer du din egen helse sånn i alminnelighet?

- ☐ Meget god
- ☐ God
- ☐ Verken god eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

4. Det neste spørsmålet handler om aktiviteter som du kanskje utfører i løpet av en vanlig dag. <u>Er din helse slik at den begrenser deg</u> i utførelsen av disse aktivitetene <u>nå</u>? Hvis ja, hvor mye?

(kryss av ett alternativ på hver linje)

	Ja, begrenser meg mye	**Ja, begrenser meg litt**	**Nei, begrenser meg ikke i det hele tatt**
a. Anstrengende aktiviteter som å løpe, løfte tunge gjenstander, delta i anstrengende idrett	☐	☐	☐
b. Moderate aktiviteter som å flytte et bord, støvsuge, gå en tur eller drive med hagearbeid	☐	☐	☐
c. Løfte eller bære en handlekurv	☐	☐	☐
d. Gå opp trappen flere etasjer	☐	☐	☐
e. Gå opp trappen en etasje	☐	☐	☐
f. Gå mer enn to kilometer	☐	☐	☐

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Questionnaire 3

5. Hvor ofte i løpet av de siste 4 ukene har du: **(kryss av ett alternative på hver linje)**

	Hele tiden	Nesten hele tiden	Mye av tiden	En del av tiden	Litt av tiden	Ikke i det hele tatt
a. Følt deg full av tiltakslyst	☐	☐	☐	☐	☐	☐
b. Følt deg veldig nervøs?	☐	☐	☐	☐	☐	☐
c. Vært så langt nede at ingenting har kunnet muntre deg opp?	☐	☐	☐	☐	☐	☐
d. Følt deg rolig og harmonisk?	☐	☐	☐	☐	☐	☐
e. Hatt mye overskudd?	☐	☐	☐	☐	☐	☐
f. Følt deg nedfor og trist?	☐	☐	☐	☐	☐	☐
g. Følt deg sliten?	☐	☐	☐	☐	☐	☐
h. Følt deg glad?	☐	☐	☐	☐	☐	☐
i. Følt deg trett?	☐	☐	☐	☐	☐	☐

6. Har du, eller har hatt:

☐ Sukkersyke (diabetes type I)

☐ Sukkersyke (diabetes type II)

Røykevaner

7. Har du røykt/røyker du daglig?

☐ Ja, nå

☐ Ja, tidligere

☐ Aldri

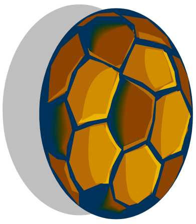
Appendix III
Questionnaire 3

Fysisk aktivitet

De neste spørsmålene handler om fysisk aktivitet. Fysisk aktivitet omfatter både:

- **fysisk aktivitet i hverdagen (i arbeid, fritid og hjemme, samt hvordan du forflytter deg til og fra arbeid og fritidssysler)**
- **planlagte aktiviteter (gå på tur, fotball, cricket, tennis, dansing)**
- **trening (for å bedre fysisk form, muskelstyrke, kondisjon og andre ferdigheter)**

8. Tenk på de siste 6 måneder, hvilke av følgende aktiviteter har du drevet med:



- ☐ Landhockey/innebandy/skøyter/bandy/hockey
- ☐ Cricket
- ☐ Svømming
- ☐ Treningsstudio (styrketrening, utholdenhetsapparater)
- ☐ Turgåing
- ☐ Ballspill
- ☐ Dans
- ☐ Sykling/spinning
- ☐ Langrenn
- ☐ Badminton/Tennis/Squash
- ☐ Alpint/snowboard
- ☐ Bordtennis
- ☐ Trening til musikk i sal
- ☐ Golf
- ☐ Stavgang
- ☐ Vanngymnastikk
- ☐ Kampsport (karate, judo, boksing)
- ☐ Padling/roing
- ☐ Yoga/pilates
- ☐ Jogging
- ☐ Annet, hva:____

9. Angi bevegelse og kroppslig anstrengelse i din fritid. Hvis aktiviteten varierer meget f.eks mellom sommer og vinter, så ta et gjennomsnitt. Spørsmålet gjelder bare det siste året (sett ett kryss i den ruta som passer best)

Lese, ser på fjernsyn eller annen stillesittende beskjeftigelse?	☐
Spaserer, sykler eller beveger deg på annen måte minst 4 timer i uka? (Her skal du regne med gang eller sykling til arbeidsstedet, søndagsturer m.m)	☐
Driver mosjonsidrett, tyngre hagearbeid e.l? (Merk at aktiviteten skal vare minst 4 timer i uka)	☐
Trener hardt eller driver konkurranseidrett regelmessig og flere ganger i uka	☐

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Questionnaire 3

Når du svarer på spørsmålene 19-20:
Meget anstrengende – er fysisk aktivitet som får deg til å puste *mye mer* enn vanlig
Middels anstrengende – er fysisk aktivitet som får deg til å puste *litt mer* enn vanlig

Det er kun aktiviteter som varer *minst 10 minutter i strekk* som skal rapporteres.

10a. Hvor mange dager i løpet av de siste 7 dager har du drevet med *meget anstrengende* fysiske aktiviteter som tunge løft, gravearbeid, aerobics eller sykle fort? Tenk bare på aktiviteter som varer *minst 10 minutter i strekk*.

☐ Dager per uke

☐ Ingen (gå til spørsmål 20a)

10b. På en vanlig dag hvor du utførte *meget anstrengende* fysiske aktiviteter, hvor lang tid brukte du da på dette?

☐ ☐ Timer ☐ ☐ Minutter ☐ Vet ikke/husker ikke

11a. Hvor mange dager i løpet av de siste 7 dager har du drevet med *middels anstrengende* fysiske aktiviteter som å bære lette ting, sykle i moderat tempo eller mosjonstennis? Ikke ta med gange.

☐ Dager per uke

☐ Ingen (gå til spørsmål 21a)

11b. På en vanlig dag hvor du utførte *middels anstrengende* fysiske aktiviteter, hvor lang tid brukte du da på dette?

☐ ☐ Timer ☐ ☐ Minutter ☐ Vet ikke/husker ikke

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Questionnaire 3

12a. Hvor mange dager i løpet av de siste 7 dager, *gikk du minst 10 minutter* i strekk for å komme deg fra ett sted til et annet? Dette inkluderer gange på jobb og hjemme, gange til buss, eller gange som du gjør på tur eller som trening i fritiden.

☐ Dager per uke

☐ Ingen (gå til spørsmål 22a)

12b. På en vanlig dag hvor du *gikk* for å komme deg fra et sted til et annet, hvor lang tid brukte du da totalt på å gå?

☐ ☐ Timer ☐ ☐ Minutter ☐ Vet ikke/husker ikke

12c. Når du forflytter deg fra et sted til et annet ved å gå, i hvilket tempo går du vanligvis?

☐ I raskt tempo ☐ I middels tempo ☐ I langsomt tempo

13a. Hender det at du bruker sykkel i løpet av en vanlig uke?

☐ Ja ☐ Nei

Hvis nei gå til spørsmål nummer 23.

13b. Hvor mange dager i *en vanlig uke* sykler du *minst 10 minutter i strekk* for å komme fra et sted til ett annet?

Om sommeren **Om vinteren**

☐ Dager per uke ☐ Dager per uke

13c. På *en vanlig dag* hvor du *sykler* for å komme deg fra et sted til ett annet, hvor lang tid bruker du da totalt på å sykle?

Om sommeren **Om vinteren**

☐ ☐ Timer ☐ ☐ Minutter ☐ ☐ Timer ☐ ☐ Minutter

13d. Når du forflytter deg fra ett sted til ett annet på sykkel, i hvilket tempo sykler du vanligvis?

☐ I raskt tempo ☐ I middels tempo ☐ I langsomt tempo

Appendix III
Questionnaire 3

De neste to spørsmålene handler om dine vaner knyttet til bruk av TV og PC utenom jobb

14. Utenom jobb: Hvor mange timer ser du vanligvis på TV og sitter med PC på en hverdag?

- ☐ Mindre enn 1 time
- ☐ 1-2 timer
- ☐ 2-3 timer
- ☐ 3-4 timer
- ☐ 4-5 timer
- ☐ Mer enn 5 timer

15. Utenom jobb: Hvor mange timer ser du vanligvis på TV og sitter med PC på en helgedag?

- ☐ Mindre enn 1 time
- ☐ 1-2 timer
- ☐ 2-3 timer
- ☐ 3-4 timer
- ☐ 4-5 timer
- ☐ Mer enn 5 timer

Holdninger til fysisk aktivitet

De neste spørsmålene handler om dine holdninger til fysisk aktivitet. Dersom du ikke prøver å være fysisk aktiv, kan det være at noen av spørsmålene ikke passer for deg. Vennligst les og svar på alle spørsmålene likevel.

16. Nedenfor følger en rekke grunner for å drive med fysisk aktivitet. Vennligst sett ett eller flere kryss for den (de) grunnen(e) som er viktige for deg.

- ☐ Forebygge helseplager
- ☐ Komme i bedre form
- ☐ Holde vekten nede
- ☐ Anbefalt av lege, fysioterapeut eller liknende
- ☐ For å se veltrent ut
- ☐ Fysisk og psykisk velvære
- ☐ Øke prestasjonsevnen
- ☐ For å treffe og omgås andre mennesker
- ☐ Gjøre fritiden trivelig
- ☐ Oppbygging etter sykdom/skade
- ☐ For å ha det gøy
- ☐ Oppleve spenning/utfordring
- ☐ Føler jeg må
- ☐ For å få frisk luft

Hvis andre grunner, hvilke:____

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Questionnaire 3

17. Tenk deg alle former for fysisk aktivitet. Ta stilling til påstanden: Jeg er sikker på at jeg kan gjennomføre planlagt fysisk aktivitet selv om:

	Ikke i det hele tatt 1	2	3	4	5	Veldig sikker 6	7
a. Jeg er trett	☐	☐	☐	☐	☐	☐	☐
b. Jeg føler meg nedtrykt	☐	☐	☐	☐	☐	☐	☐
c. Jeg er bekymret	☐	☐	☐	☐	☐	☐	☐
d. Jeg er sint på grunn av noe	☐	☐	☐	☐	☐	☐	☐
e. Jeg føler meg stresset	☐	☐	☐	☐	☐	☐	☐
f. Været er dårlig	☐	☐	☐	☐	☐	☐	☐
g. Jeg har mye å gjøre/liten tid	☐	☐	☐	☐	☐	☐	☐

18. Tenk på alle former for fysisk aktivitet. For hver påstand, angi i hvilken grad du er enig/uenig. *For hver påstand, sett ett kryss*

	Helt enig 1	2	3	4	5	6	Helt uenig 7
a. Om jeg er regelmessig fysisk aktiv eller ikke er helt opp til meg	☐	☐	☐	☐	☐	☐	☐
b. Hvis jeg ville, hadde jeg ikke hatt noen problemer med å være regelmessig fysisk aktiv	☐	☐	☐	☐	☐	☐	☐
c. Jeg ville likt å være regelmessig aktiv, men jeg vet ikke riktig om jeg kan	☐	☐	☐	☐	☐	☐	☐
d. Jeg har full kontroll over å være regelmessig fysisk aktiv	☐	☐	☐	☐	☐	☐	☐
e. Å være regelmessig fysisk aktiv er vanskelig for meg	☐	☐	☐	☐	☐	☐	☐

19. I hvilken grad beskriver disse påstandene deg som person?

	Passer dårlig 1	2	3	4	Passer bra 5
a. Jeg ser på meg selv som en person som er opptatt av fysisk aktivitet	☐	☐	☐	☐	☐
b. Jeg tenker på meg selv som en person som er opptatt av å holde seg i god fysisk form	☐	☐	☐	☐	☐
c. Å være fysisk aktiv er en stor del av hvem jeg er	☐	☐	☐	☐	☐

Appendix III
Questionnaire 3

20. I hvilken utstrekning mener du at daglig fysisk aktivitet kan ha gunstig effekt for å forebygge følgende sykdommer:

	Stor effekt	Liten effekt	Ingen effekt	Vet ikke
Hjerte- og karsykdom	☐	☐	☐	☐
Muskel-skjelettlidelser	☐	☐	☐	☐
Diabetes type 2	☐	☐	☐	☐
Kreft	☐	☐	☐	☐
Høyt blodtrykk	☐	☐	☐	☐
Psykiske lidelser	☐	☐	☐	☐
Overvekt og fedme	☐	☐	☐	☐
Mage-/tarmsykdommer	☐	☐	☐	☐
Astma og allergi	☐	☐	☐	☐
KOLS	☐	☐	☐	☐

21. Her har skalaen 5 punkter fra "Ingen" til "Alle"

Av folk du kjenner godt – hvor mange er fysisk aktive minst 3 ganger i uka?	☐ Ingen	☐ Noen få	☐ En god del	☐ De aller fleste	☐ Alle

22. Her har skalaen 4 punkter fra "Helt uenig" til "Helt enig"
Tenk på deg selv nå for tiden. Folk som er viktige for meg:

a. Synes jeg bør være fysisk aktiv	☐ Helt uenig	☐ Litt uenig	☐ Litt enig	☐ Helt enig
b. Synes det er bra om jeg er fysisk aktiv	☐ Helt uenig	☐ Litt uenig	☐ Litt enig	☐ Helt enig
c. Vil at jeg skal være fysisk aktiv	☐ Helt uenig	☐ Litt uenig	☐ Litt enig	☐ Helt enig
d. Synes det er upassende at jeg er fysisk aktiv	☐ Helt uenig	☐ Litt uenig	☐ Litt enig	☐ Helt enig
e. Liker ikke at jeg er fysisk aktiv	☐ Helt uenig	☐ Litt uenig	☐ Litt enig	☐ Helt enig

Appendix III
Questionnaire 3

23. Har familien din (medlemmer i husstanden):

	Aldri	Sjelden	Noen få ganger	Ofte	Veldig ofte	Passer ikke
a. Oppmuntret deg til å være fysisk aktiv	☐	☐	☐	☐	☐	☐
b. Diskutert fysisk aktivitet sammen med deg	☐	☐	☐	☐	☐	☐
c. Forandret planene sine slik at dere kunne drive fysisk aktivitet sammen	☐	☐	☐	☐	☐	☐
d. Overtatt oppgaver for deg, slik at du fikk mer tid til å være fysisk aktiv	☐	☐	☐	☐	☐	☐
e. Sagt at fysisk aktivitet vil være bra for helsen din	☐	☐	☐	☐	☐	☐
f. Snakket om hvor godt de liker å være fysisk aktive	☐	☐	☐	☐	☐	☐

24. Har vennene dine/bekjente/familiemedlemmer utenfor husstanden:

	Aldri	Sjelden	Noen få ganger	Ofte	Veldig ofte	Passer ikke
a. Foreslått at dere skulle drive fysisk aktivitet sammen	☐	☐	☐	☐	☐	☐
b. Oppmuntret deg til å være fysisk aktiv	☐	☐	☐	☐	☐	☐
c. Gitt deg hjelpsomme påminnelser om fysisk aktivitet som: ”Skal du mosjonere i kveld?”	☐	☐	☐	☐	☐	☐
d. Forandret planene sine slik at dere kunne drive fysisk aktivitet sammen	☐	☐	☐	☐	☐	☐
e. Sagt at fysisk aktivitet vil være bra for helsen din	☐	☐	☐	☐	☐	☐
f. Snakket om hvor godt de liker å være fysisk aktive	☐	☐	☐	☐	☐	☐

Appendix III
Questionnaire 3

25. Ta stilling til påstanden: "At jeg er regelmessig fysisk aktiv i løpet av <u>den neste måneden</u> vil være...:" Sett kryss i den ruta som samsvarer med din oppfatning. Tenk på alle former for fysisk aktivitet

		1	2	3	4	5	6	7	
a.	Dumt	☐	☐	☐	☐	☐	☐	☐	Klokt
b.	Skadelig	☐	☐	☐	☐	☐	☐	☐	Verdifullt
c.	Unyttig	☐	☐	☐	☐	☐	☐	☐	Nyttig
d.	Galt	☐	☐	☐	☐	☐	☐	☐	Riktig
e.	Brysomt	☐	☐	☐	☐	☐	☐	☐	Lettvint
f.	Ubehagelig	☐	☐	☐	☐	☐	☐	☐	Behagelig
g.	Ille	☐	☐	☐	☐	☐	☐	☐	Bra
h.	Kjedelig	☐	☐	☐	☐	☐	☐	☐	Interessant

26. Ta stilling til påstanden: "Hvis jeg er fysisk aktiv regelmessig i løpet av <u>den neste måneden</u>….." Sett kryss i den ruta som samsvarer med din oppfatning. Tenk på alle former for fysisk aktivitet:

		Usannsynlig						Høyst sannsynlig
		1	**2**	**3**	**4**	**5**	**6**	**7**
a.	Vil jeg komme i bedre form	☐	☐	☐	☐	☐	☐	☐
b.	Vil jeg føle meg bedre	☐	☐	☐	☐	☐	☐	☐
c.	Vil jeg få mer overskudd	☐	☐	☐	☐	☐	☐	☐
d.	Vil det løse opp spenninger og stress i kroppen	☐	☐	☐	☐	☐	☐	☐
e.	Vil jeg komme i bedre humør	☐	☐	☐	☐	☐	☐	☐
f.	Vil jeg gå ned i vekt	☐	☐	☐	☐	☐	☐	☐
g.	Vil jeg få mindre tid til andre ting	☐	☐	☐	☐	☐	☐	☐
h.	Vil det koste meg mye penger	☐	☐	☐	☐	☐	☐	☐
i.	Kan jeg pådra meg skader	☐	☐	☐	☐	☐	☐	☐

Appendix III
Questionnaire 3

27. Nedenfor følger en rekke ting som noen oppgir som hindring for å være fysisk aktiv. Ranger hvor stor de enkelte er en hindring for deg.

	Ikke aktuell 0	1	2	3	4	Veldig aktuell 5
a. Lite tid	☐	☐	☐	☐	☐	☐
b. Ikke den sporty typen	☐	☐	☐	☐	☐	☐
c. For dårlig form	☐	☐	☐	☐	☐	☐
d. Dårlig vær	☐	☐	☐	☐	☐	☐
e. Liten motivasjon	☐	☐	☐	☐	☐	☐
f. For dyrt	☐	☐	☐	☐	☐	☐
g. Føler med nedtrykt	☐	☐	☐	☐	☐	☐
h. Bekymringer	☐	☐	☐	☐	☐	☐
i. Stress	☐	☐	☐	☐	☐	☐
j. Vil heller drive med andre ting	☐	☐	☐	☐	☐	☐
k. Mangel på lokaler/uteområde	☐	☐	☐	☐	☐	☐
l. Vet ikke hvordan	☐	☐	☐	☐	☐	☐
m. Ingen å drive aktivitet sammen med	☐	☐	☐	☐	☐	☐
n. Finner ikke aktiviteter som er ok å drive med	☐	☐	☐	☐	☐	☐
o. Dårlig helse	☐	☐	☐	☐	☐	☐

Annet____

28. Er det i ditt nærmiljø:

	Helt uenig	Litt uenig	Litt enig	Helt enig
a. Trygge steder å gå (park/friområde, turvei, fortau) som er tilstrekkelig opplyst	☐	☐	☐	☐
b. Mange steder der du kan være fysisk aktiv (utendørs, svømmehall etc.)	☐	☐	☐	☐
c. Flere tilrettelagte tilbud om trening og fysisk aktivitet (som kunne være aktuelle for deg)	☐	☐	☐	☐
d. Greit å gå til butikker (10-15 min å gå, fortau langs de fleste veiene)	☐	☐	☐	☐
e. Lett tilgang til gang- eller sykkelveier	☐	☐	☐	☐
f. Så mye trafikk i gatene at det er vanskelig eller lite hyggelig å gå	☐	☐	☐	☐
g. Fotgjengeroverganger og lyssignal som gjør det enklere å krysse veien	☐	☐	☐	☐

Appendix III
Questionnaire 3

29. Her lurer vi på <u>hvorfor du er fysisk aktiv</u>. Se på påstandene nedenfor, og ring rundt det alternativet som passer best for deg. Benytt følgende skala:

	Ikke sant for meg 1	2	Delvis sant 3	4	Veldig sant 5
Jeg er fysisk aktiv fordi:					
a. Det er viktig for meg……………………………………………	1	2	3	4	5
b. Jeg føler meg skamfull når jeg ikke er fysisk aktiv………..	1	2	3	4	5
c. Det er av stor betydning for meg personlig…………………	1	2	3	4	5
d. Andre sier at jeg skal gjøre det………………………………	1	2	3	4	5
e. Jeg setter pris på det…………………………………………	1	2	3	4	5
f. Det er forventet av meg………………………………………	1	2	3	4	5
g. Fordelene med å trene betyr mye for meg…………………	1	2	3	4	5
h. Det er gøy……………………………………………………..	1	2	3	4	5
i. Jeg føler et press fra andre til å være fysisk aktiv………..	1	2	3	4	5
j. Jeg liker å bevege meg…………………………………..	1	2	3	4	5
g. Jeg føler meg skyldig hvis jeg ikke er fysisk aktiv……….	1	2	3	4	5
h. Det er interessant for meg…………………………………	1	2	3	4	5
i. Min ektefelle/venner/familie sier at jeg skal gjøre det…..	1	2	3	4	5
j. Jeg har glede av å være i aktivitet………………………..	1	2	3	4	5
k. Jeg føler meg mislykket om jeg ikke er fysisk aktiv…….	1	2	3	4	5
l. Andre ikke skal bli skuffet over meg………………………	1	2	3	4	5
m. Jeg blir glad og tilfreds av å trene…………………………	1	2	3	4	5
n. Det er viktig for meg å trene regelmessig………………..	1	2	3	4	5

Andre grunner:____

Søvn

30) Hvor mange timer i døgnet sover du vanligvis på hverdager?

- ☐ Mindre enn 3 timer
- ☐ 3 - 5 timer
- ☐ 5 - 8 timer
- ☐ 8 - 10 timer
- ☐ 10 timer eller mer

31) Hvor mange timer i døgnet sover du vanligvis på helgedager eller fridager?

- ☐ Mindre enn 3 timer
- ☐ 3 - 5 timer
- ☐ 5 - 8 timer
- ☐ 8 - 10 timer
- ☐ 10 timer eller mer

Appendix III
Questionnaire 3

Kosthold

1. Tenk tilbake på de siste 14 dager. Hvor ofte har du drukket følgende drikker og hvor mye har du drukket per. gang?
Kryss av (x) for hvor ofte og hvor mye per. gang der det er aktuelt.
Eksempel: har du drukket coladrikker med sukker disse dagene? Hvis ja, hvor ofte har du drukket slike drikker? Og hvor mye per. gang der det er aktuelt?

	Frekvens						**Mengde**			
	Ikke drukket	< 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	Daglig	1/5 l	1/3 l	½ l	1+ l
Coladrikk med sukker	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Annen brus med sukker	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. Hvis du drikker te eller kaffe, hvor mange teskjeer sukker og/eller honning bruker du?

	Bruker ikke sukker/honning	1ts	2ts	3ts	4ts	≥5 ts
Antall teskjeer sukker/honning i te	☐	☐	☐	☐	☐	☐
Antall teskjeer sukker i kaffe	☐	☐	☐	☐	☐	☐

3. Tenk tilbake på de siste 14 dager. Hvor ofte har du spist frukt og/eller bær?

	Aldri eller < 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	1 g/dag	2 g/dag	≥ 3 g/dag
Frisk frukt, bær, fruktsalat/fruktchaart el.l.	☐	☐	☐	☐	☐	☐	☐

4. Tenk tilbake på de siste 14 dager. Hvor ofte har du spist grønnsaker?

	Aldri eller < 1 g/uke	1-2 g/uke	3-4 g/uke	5-6 g/uke	1 g/dag	2 g/dag	≥ 3 g/dag
Rå grønnsaker, blandede grønnsaker/grønnsakschaart, salater	☐	☐	☐	☐	☐	☐	☐
Stekte/wokkede grønnsaker, kokte/dampede/ovnsbakte grønnsaker, grønnsaker i gryte (for eksempel curry, salen)	☐	☐	☐	☐	☐	☐	☐

5. Hvor ofte pleier du å spise følgende måltider i løpet av en uke?
(Sett ett kryss for hvert måltid)

	Aldri/sjeldent	1 gang i uken	2 ganger i uken	3 ganger i uken	4 ganger i uken	5 ganger i uken	6 ganger i uken	Hver dag
Frokost	☐	☐	☐	☐	☐	☐	☐	☐
Lunsj	☐	☐	☐	☐	☐	☐	☐	☐
Middag	☐	☐	☐	☐	☐	☐	☐	☐
Kveldsmat	☐	☐	☐	☐	☐	☐	☐	☐

Appendix III
Questionnaire 3

NORGES IDRETTSHØGSKOLE

FAM studien

Appendix IV

Approval letter from the Regional Committee for Medical Research Ethics

Appendix IV
Approval letter from the Regional Committee for Medical Research Ethics

UNIVERSITETET I OSLO

DET MEDISINSKE FAKULTET

Professor dr.med. Arne Høstmark
Institutt for allmenn- og samfunnsmedisin
Universitetet i Oslo
Pb.1130 Blindern
0318 Oslo

Regional komité for medisinsk forskningsetikk
Sør- Norge (REK Sør)
Postboks 1130 Blindern
NO-0318 Oslo

Telefon: 228 50 670
Telefaks: 228 44 661
E-post: jorunn.lindholt@medisin.uio.no
Nettadresse: www.etikkom.no

Dato: 25.09.07
Deres ref.:
Vår ref.: S-07300b

S-07300bb Fysisk aktivitet og minoritetshelse [2.2007.1204]

Vi viser til brev datert 17.09.2007 med svar på merknader og revidert informasjonsskriv med samtykkeerklæring vedlagt.

Komiteen tar svar på merknader til etterretning og har ingen merknader til revidert informasjonsskriv og samtykkeerklæring.

Vedtak
Komiteen godkjenner prosjektet.

Komiteen videresender skjema for opprettelse av forskningsbiobank, revidert informasjonsskriv samt komiteens vedtak til Sosial- og helsedirektoratet for endelig behandling av spørsmålet om opprettelse av forskningsbiobank.

Med vennlig hilsen

Tor Norseth
Leder

Jorunn Lindholt
Sekretær

Kopi: Doktorgradsstipendiat Eivind Andersen, e-post: eivind.andersen@nih.no
Sosial- og Helsedirektoratet

Appendix V

Approval letter from the Norwegian Social Science Data Service

Appendix V
Approval letter from the Norwegian Social Science Data Service

Eivind Andersen
Seksjon for idrettsmedisinske fag
Norges idrettshøgskole
Postboks 4014 Ullevål Stadion
0806 OSLO

Vår dato: 10.09.2007	Vår ref: 17212 / 2 / KS	Deres dato:	Deres ref:

TILRÅDING AV BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 02.07.2007. All nødvendig informasjon om prosjektet forelå i sin helhet 07.09.2007. Meldingen gjelder prosjektet:

17212	*Intervensjon med fysisk aktivitet for å forebygge diabetes type 2/metabolsk syndrom hos Pakistanske innvandrermenn bosatt i Oslo*
Behandlingsansvarlig	*Norges idrettshøgskole, ved institusjonens øverste leder*
Daglig ansvarlig	*Eivind Andersen*

Personvernombudet har vurdert prosjektet, og finner at behandlingen av personopplysninger vil være regulert av § 7-27 i personopplysningsforskriften. Personvernombudet tilrår at prosjektet gjennomføres.

Personvernombudets tilråding forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, eventuelle kommentarer samt personopplysningsloven/-helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/melding/pvo_endringsskjema.cfm. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://www.nsd.uib.no/personvern/register/.

Personvernombudet vil ved prosjektets avslutning, 01.12.2010, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Vigdis Namtvedt Kvalheim   Katrine Utaaker Segadal

Kontaktperson: Katrine Utaaker Segadal tlf: 55 58 35 42
Vedlegg: Prosjektvurdering

Appendix V
Approval letter from the Norwegian Social Science Data Service

Personvernombudet for forskning

Prosjektvurdering - Kommentar

17212

Det vil i prosjektet bli registrert sensitive personopplysninger om helseforhold, jf. personopplysningsloven § 2 nr. 8 c).

Prosjektslutt er angitt til 01.12.10. Senest ved prosjektslutt vil datamaterialet være anonymisert. Med anonyme opplysninger forstås opplysninger som ikke på noe vis kan identifisere enkeltpersoner i et datamateriale, verken direkte gjennom navn eller personnummer, indirekte gjennom bakgrunnsvariabler eller gjennom navneliste/koblingsnøkkel eller krypteringsformel og kode.

Ombudet har mottatt revidert informasjonsskriv (e-post 07.09.07) og finner dette tilfredsstillende så fremt det legges til at alle opplysninger anonymiseres ved prosjektslutt (ikke bare prøvene).

Prosjektet og opprettelsen av biobank er meldt til Regional komité for medisinsk og helsefaglig forskningsetikk. Kopi av tilråding bes ettersendt når denne foreligger.

Appendix VI

The Norwegian Directorate of Health: the Biobank act

Appendix VI
The Norwegian Directorate of Health: the Biobank act

S-07300b
2.2007.1204

KOPI

Sosial- og helsedirektoratet

MOTTATT
9 NOV 2007
REK Sør

Universitetet i Oslo
Professor dr. med. Arne Høstmark
Institutt for allmenn- og samfunnsmedisin
Postboks 1130 Blindern
0318 OSLO

Deres ref.:
Saksbehandler: BEB
Vår ref.: 07/5064-
Dato: 24.10.2007

Melding om opprettelse av forskningsbiobank: Norges idrettshøgskole - Fysisk aktivitet og minoritetshelse

Vi viser til brev vedrørende ovennevnte. Sosial- og helsedirektoratet er delegert å vurdere meldinger om opprettelse av forskningsbiobanker i henhold til biobankloven § 4.

Direktoratet har ingen innsigelser til at forskningsbiobanken opprettes i henhold til biobankloven.

Direktoratet forutsetter at opprettelsen av den planlagte forskningsbiobanken oppfyller nødvendige krav til godkjenning, konsesjon m.v. i henhold til annet relevant regelverk, herunder bioteknologiloven, helseregisterloven og legemiddelloven.

Meldingen om forskningsbiobanken vil bli sendt til Nasjonalt folkehelseinstitutt som har fått ansvaret for å føre et offentlig tilgjengelig register over landets biobanker, jf. biobankloven § 6.

Vennlig hilsen

Ragnhild Castberg e.f.
avdelingsdirektør

Bente Bryhn
førstekonsulent

Kopi: REK Sør, ref. S-07300b
Biobankregisteret, ref. 1988
Eivind Andersen, Lilleveien 7, 0754 Oslo

Sosial- og helsedirektoratet
Avd. bioteknologi og generelle helselover
Bente Bryhn, tlf.: 24 16 32 73
Postadresse: Postboks 7000 St. Olavs plass, 0130 Oslo • Besøksadresse: Universitetsgata 2, Oslo
Tlf.: 810 20 050 • Faks: 24 16 30 01 • Org. nr.: 983 544 622 • postmottak@shdir.no • www.shdir.no

Appendix VI
The Norwegian Directorate of Health: the Biobank act

MOTTATT
REK Sør

S-07300

folkehelseinstituttet
Biobankregisteret

Kalfarveien 31 NO-5018 Bergen Norway | Tlf. 53 20 40 05 |
biobankregisteret@fhi.no

Biobankregisteret har nå registrert din søknad om opprettelse av forskningsbiobank, utførsel av biobankmateriale og endret, utvidet eller ny bruk av tidligere innsamlet materiale

Melding nr: 1988 Meldingen går til: REK Sør REK prosjektnr. 2.2007.1204 Dato: 03.07.2007

Forskningsbiobankens navn og evt. navn på prosjektet knyttet til biobanken (kort beskrivelse)

Fysisk aktivitet og minoritetshelse

1. Henter forskningsbiobanken materiale fra en allerede eksisterende diagnostikk- og behandlingsbiobank? Nei
2. Ansvarshavende for biobanken, jf.Biobanklovens §7

. Navn: Arne T. Høstmark . E-post: a.t.hostmark@medisin.uio.no . Stilling: Professor

. Adresse: Sognsveien 220 . Postnr: 0806 . Poststed: Oslo

. Utdanning: . Institusjon/sykehus: Norges idrettshøgskole

3a. Databehandlingsansvarlig etter personopplysningsloven/helseregisterloven

. Navn: Arne T. Høstmark . Institusjon/sykehus: Norges idrettshøgskole

3b. Ansvarshavende institusjon/øverste ansvarshavende kontaktperson

. Navn: Roald Bahr . E-post: roald.bahr@nih.no

. Institusjon/sykehus: Norges idrettshøgskole . Stilling: seksjonsleder

4. Formålet med opprettelsen av forskningsbiobanken

Formålet med prosjektet er å øke det fysiske aktivitetsnivået hos pakistanske menn i Oslo. Dette prøves gjennom tilrettelagte programmer og informasjon. Forsøkspersonene skal ha noe forhøyet risiko for å utvikle diabetes type 2. For å kunne evaluere effekten av programmet og treningseffekten er det viktig for oss å ha harde data (blodprøver) slik at analysene blir mest mulig objektive.

5. På hvilken måte er personopplysningene beskyttet?

Personopplysninger vil oppbevares på en passordbeskyttet PC som er innelåst etter arbeidstid.

6. Hva slags humant materiale skal banken inneholde og fra hvor mange skal det samles prøver?

☑ fullblod	400	frosset	minus 70 grader C
☑ serum	400	frosset	minus 70 grader C
☑ plasma	400	frosset	minus 70 grader C

Hvilke analyser skal utføres på prøvematerialet?

Glukose, insulin, albumin, HbA1c, cytokiner, triglyserider, HDL-kolesterol, LDL-kolesterol, sd-kolesterol, C-peptid.

- Totalt antall personer som har avgitt eller skal avgi materiale til biobanken: 200

7. Identifisering av prøver:

Kan prøvene knyttes til individ? Ja

Hvis ja, på hvilken måte? avidentifisert |

8. Opplysninger om prosjektdeltakere som har levert prøver

Variabelliste er vedlagt Nei

Diagnoser med tilknytning til prosjektet (Hvis aktuelt, kryss for mer enn én)

9. Biobankens varighet og innhold

A. Det biologiske materialet

A4. Alt biologisk materiale vil bli oppbevart etter prosjektslutt

Oppbevares til år: 2020 avidentifisert

B. Analyseresultatene

B3. Alle analyseresultater vil bli oppbevart etter prosjektslutt

Oppbevares til år: 2020 avidentifisert

10. Redegjør for eventuelle planer om kobling til andre opplysninger/registre

Ikke aktuelt

11. Hvordan skal samtykke innhentes? (hvis aktuelt, kryss for mer enn én)

Skriftlig,spesifikt for prosjektet |

12. Drøft etiske spørsmål knyttet til opprettelsen av biobanken (se vurderingsgrunnlaget)

    Ingen etiske spørsmål.

13. Overføring til utlandet Nei

    3) Identifisering av prøver ved overføring til utlandet

       Kan prøvene knyttes til individ?

    4) Skal materialet returneres til Norge etter at prosjektet er avsluttet?

15. Hvordan er forskningsbiobanken finansiert? Redegjør for eventuelle planer for kommersiell bruk av materialet

    Forskningsbiobanken er finansiert av NIH. Det foreligger ingen kommersiell bruk av materialet.

16. Kopi av vedtak ønskes sendt til (navn, institusjon, adresse, e-post)

    Eivind Andersen Lilleveien 7 0754 Oslo eivind.andersen@nih.no

Sted: Oslo **Dato:** 9/7 -07 **Signatur:** [signature]

- Skriv ut biobankskjemaet, signer og send det i 12 papirformat eksemplarer sammen med de øvrige dokumentene for etisk vurdering av forskningsprosjekt i REK i henhold til saksbehandlingsprosedyrer og veiledning på etikkom.no
- Dokumentene må være mottatt innen angitt frist til sekretariatet i din region. Innleveringsfrister og møtedatoer finner du på www.etikkom.no
- Dokumentene sendes til sekretariatet i din region:
  - Regional komité for medisinsk forskningsetikk, Øst-Norge (REK Øst)
    Postboks 1130, Blindern, 0318 Oslo
  - Regional komité for medisinsk forskningsetikk, Sør-Norge (REK Sør)
    Postboks 1130, Blindern, 0318 Oslo
  - Regional komité for medisinsk forskningsetikk, Vest-Norge (REK Vest)
    Universitetet i Bergen, Det medisinske fakultet, Postboks 7800, 5020 Bergen
  - Regional komité for medisinsk forskningsetikk, Midt-Norge (REK Midt-Norge)
    Det medisinske fakultet, Medisinsk teknisk forskningssenter N-7489 Trondheim
  - Regional komité for medisinsk forskningsetikk, Nord-Norge (REK Nord)
    Universitetet i Tromsø, Det medisinske fakultet,9037 Tromsø

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NORGES IDRETTSHØGSKOLE

Vil du delta i et forskningsprosjekt?

Norges idrettshøgskole er opptatt av helsemessige virkninger av fysisk aktivitet. Nå planlegges doktorgradsprosjektet: *"Fysisk aktivitet og forebyggelse av diabetes hos menn med pakistansk bakgrunn"*, og vi inviterer **DEG** til å delta.

Vårt mål er at du skal:

- **redusere risikoen din for å utvikle sukkersyke (diabetes type 2) og hjerte- og karsykdommer**
- **hvis overvektig: gå ned i vekt**
- **komme i bedre form**
- **få mer overskudd slik at du orker mer**
- **bli sterkere og mer utholdende**
- **kjenne gleden ved å trene**
- **øke ditt fysiske aktivitetsnivå**

Å være fysisk inaktiv og/eller overvektig kan være skadelig for helsen, fordi man da har større risiko for å utvikle alvorlige sykdommer, blant annet sukkersyke og hjerte- og karsykdommer. Det er grunn til å anta at kun en liten økning i ditt fysiske aktivitetsnivå kan redusere risikoen betydelig.

Derfor ønsker vi, i samarbeid med deg, å utvikle en individuelt tilpasset aktivitetsplan, og undersøke om programmet kan påvirke din helse i gunstig retning.

Vi inviterer deg som deltaker i prosjektet hvis du oppfyller disse kriteriene:

- Er mann i alderen 25-50 år
- Ikke trener veldig mye (mindre enn to ganger i uka)
- Har pakistansk opprinnelse

Du vil få gratis trening i 4 måneder, oppfølging hele veien og gratis helsesjekk før og etter prosjektet. Du vil også få mulighet til å teste kondisjonen din på Norges idrettshøyskole.

Treningsprogrammet vil bli utarbeidet i samarbeid med gruppen. Det betyr at du har stor mulighet til å påvirke hva vi skal gjøre i disse timene vi er samlet til trening. Treningen vil foregå der du bor, to ganger i uken sammen med venner, bekjente og folk fra nabolaget.

Deltagerne vil bli testet før og etter treningsperioden. Dette innebærer en blodprøve, utfylling av et spørreskjema og måling av kondisjon. I tillegg til treningen vil du få informasjon om fysisk aktivitet og dets mulige positive effekter på helsen. Alle vil også få tilbud om treningsveiledning og hjelp til målsetting. De som ønsker det kan få tett oppfølging. I tillegg til at vi ønsker at du, ved å følge dette treningsprogrammet, skal trene mer er det også et mål at vi sammen skal finne måter å øke din hverdagsaktivitet på gjennom å gjøre enkle grep.

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Når forsøket starter vil en forsøksgruppene (15-20 mann) enten plasseres i treningsgruppe eller kontrollgruppe. Prosjektet varer i 4 måneder. De som kommer i treningsgruppe begynner å trene med en gang, mens havner du i en kontrollgruppe får du ikke mulighet til å bli med i en slik gruppe. Kontrollgruppen får til gjengjeld tilgang på et treningsprogram, organisert trening på Norges idrettshøyskole etter at det har gått 6 måneder og et kort foredrag om fysisk aktivitet og helse.

- ✓ **Du skal få trene der du bor med venner og bekjente**
- ✓ **Du vil få kunnskap om kropp, trening og helse**
- ✓ **Du vil få muligheten til å være med å utforme treningsprogrammet i samarbeid med forskere på Norges idrettshøgskole.**

Prosjektet er frivillig og du kan når som helst og enkelte trekke deg og dine testresultater fra studien uten å oppgi grunn. Det vil si at den som ønsker å tilbakekalle samtykket, kan kreve at alle prøveresultater, helse- og personopplysninger blir slettet (ansvarshavende for forskningsbiobanken er Hans Tranekjær). Dette gjelder ikke dersom de allerede inngår i vitenskapelige arbeider. Du vil ikke få noen økonomisk betaling for å delta, men vil få dekket dine reiseutgifter ved behov.

Innhentede data og resultatene av blodprøvene vil bli behandlet konfidensielt. Forsker er underlagt taushetsplikt. Ved publisering vil resultatene presenteres på en slik måte at enkeltpersoner ikke kan gjenkjennes. Forsøkspersonene vil få tilgang til sine egne resultater. Resultatene vil bli brukt som grunnlag for en doktorgrad. Den ventes avlagt i løpet av 2011, og da vil alle prøver bli anonymisert.

Vi mener at prosjektet ikke innebærer noen risiko, men treningen vil kunne føre til noe stive og slitne muskler de første ukene. Dette vil gi seg etter hvert som du kommer i bedre fysisk form. Kondisjonstesten kan av mange oppfattes som slitsom, og varer i ca 10min.

Prosjektet er tilrådd av Regional komité for medisinsk forskningsetikk (REK sør B). Prosjektet er godkjent av Personvernombudet for forskning.

Ønsker du å være med og/eller trenger mer informasjon om prosjektet før du bestemmer deg er du hjertelig velkommen til å kontakte oss:
Eivind Andersen: tlf. 23262449 / 23262000 eller email; eivind.andersen@nih.no
Du kan også gå inn på www.nih.no/FAM for mer informasjon.

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NORGES IDRETTSHØGSKOLE

Samtykke om deltagelse

Prosjektet er frivillig og jeg kan trekke meg når som helst uten å oppgi årsak. Jeg ønsker å delta i prosjektet.

Navn (blokkbokstaver):…………………………………

Underskrift:…………………………………..

Appendix VIII

Table: Rating of intervention components

Appendix VIII
Rating of intervention components

Group lectures	2.6 (0.9)
Group exercise classes	3.7 (0.5)
Individual counselling session	3.1 (0.7)
Written material	2.3 (0.9)
Phone call	2.4 (0.9)
Trainer	3.5 (0.7)
Testing	3.1 (0.8)
Exercising with others	3.7 (0.6)

Data are presented as means ± standard deviation. The participants were asked to rate how important the different intervention components had been for them in becoming more physically active. The scale went from 1 (not helpful at all) to 4 (very helpful).