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Healthier than the rest?

Physical activity and cardiovascular disease risk factors in adults in the county of Sogn & Fjordane, Norway

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Sammendrag på norsk

Innledning: Fysisk aktivitet (FA) er viktig for å opprettholde god helse og forebygge ikke-smittsomme sykdommer som hjerte- og karsykdom (HKS). Det er imidlertid observert lave nivåer av FA over hele verden. Overvåking av risikofaktorer for HKS, objektivt målt FA, og deres korrelater er viktig for overvåking av helsetilstand og vurdering av effekten av folkehelsetiltak for å øke FA. Slike data er nødvendig i den norske befolkningen, og fordi lokale variasjoner kan forekomme, er regionale data viktig. Av spesiell interesse er Sogn og Fjordane, et landlig norsk fylke som ble inkludert i Statens helseundersøkelser (SHUS) på midten av 1970-tallet på grunn av sin gunstige posisjon med hensyn til HKS sykelighet, dødelighet, forventet levealder og helse atferd.

Hensikten med studien: De overordnede målene med denne avhandlingen var å øke vår kunnskap om status og trender i FA og risikofaktorer for HKS hos voksne i Sogn og Fjordane, utforske korrelater for FA i denne populasjonen, og der det er hensiktsmessig, gjøre sammenligninger med resten av Norge.

Materiale og metode: Denne avhandlingen er basert på tre separate studier; Kan-undersøkelsen i Sogn og Fjordane (Kan1S&Fj) i 2008-2010 (Artikkel I-IV), SHUS i 1975-1999 (Artikkel II og III) og den nasjonale Kan1-undersøkelsen i 2008-2010 (Artikkel II og IV). I tverrsnittsundersøkelsen i Artikkel I var 622 40-42- og 53-55-åringer (svarprosent 61%) fra Sogn og Fjordane inkludert. Den repetitive tverrsnittsstudien i Artikkel II omfatter data fra 375 682 40-42-åringer (svarprosent 94-32%) fra Sogn og Fjordane og resten av Norge. I den prospektive observasjonsstudien i Artikkel III, ble helsetilstanden og -vanene til 240 40-42-åringer (svarprosent 52%) fra Sogn og Fjordane fulgt etter 13 år, mens Artikkel IV er basert på tverrsnittsdata fra 972 40-42- og 53-55-åringer (svarprosent 40%) fra Sogn og Fjordane og resten av Norge. Fysisk aktivitet ble registrert ved selvrapportering (alle studier) og objektive mål (Kan1S&Fj og Kan1), mens risikofaktorer for HKS og potensielle korrelater for FA ble registrert gjennom spørreskjemaer og fysiske undersøkelser (alle studier).

Hovedresultater: Til tross for betydelig høyere objektivt målt FA nivå i Sogn og Fjordane sammenlignet med resten av Norge (44% vs. 29% tilfredsstilte anbefalinger for FA, $p < 0{,}001$), er FA nivået lavt. Vi fant ingen kjønnsforskjeller i objektivt målt totalt FA nivå i fylket, men signifikante kjønnsforskjeller ble observert for stillesittende tid, lett- og moderat aktivitet (Artikkel I).

Selvrapportert FA nivå i fritiden har vært relativt stabilt over en 35-års periode, og ingen signifikante forskjeller i utvikling ble observert mellom Sogn og Fjordane og resten av Norge (Artikkel II). En reduksjon ble observert i stillesittende atferd (for kvinner), moderat FA, røyking, systolisk blodtrykk (SBT), diastolisk blodtrykk (DBT), high-density lipoprotein-kolesterol (HDL-c) og total kolesterol (TK), mens en økning ble observert for stillesittende atferd (for menn), lett FA (for kvinner), hard FA, kroppsmasse indeks (KMI) og triglyserider (TG). Sammenlignet med de nasjonale trendene, hadde 40-42-åringer fra Sogn og Fjordane gunstigere utvikling i TG, HDL-c og KMI men mindre gunstig utvikling I SBT og DBT (Artikkel II).

Selvrapportert FA ($p < 0,001$) og bedring i egenvurdert helse ($p = 0,046$) hadde en positiv sammenheng med objektivt målt moderat til hard FA (MHFA) ved oppfølging, mens KMI ($p = 0,034$) og økt KMI ($p = 0,014$) hadde en negativ sammenheng med MHFA ved oppfølging (Artikkel III). Objektivt målt FA hadde en positiv sammenheng med fysiske miljøfaktorer som tilrettelegging for gange, bruk av aktiv transport og det å bo i Sogn og Fjordane, mens en negativ sammenheng ble funnet med en nærmiljøskåre som beskriver hvor aktivitetsvennlig nærmiljøet deres er (alle $p \leq 0,004$). Geografiske forskjeller i korrelater mellom Sogn og Fjordane og resten av Norge ble observert for et aktivitetsvennlig nærmiljø og bruk av offentlig transport (Artikkel IV).

Konklusjoner: Denne første epidemiologiske undersøkelsen av objektivt målt FA og korrelater for FA hos voksne i Sogn og Fjordane, viser at denne befolkningsgruppen har opprettholdt mer positive egenskaper i form av FA nivå og flere andre risikofaktorer for HKS sammenlignet med resten av Norge. I et folkehelseperspektiv er imidlertid FA nivået fortsatt for lavt, tatt i betraktning den overbevisende dokumentasjonen på de helsemessige fordelene av FA for de som er tilstrekkelig fysisk aktive. Derfor er det nå på tide å gjøre FA til et hovedmål for folkehelsekampanjer og –politikk, for effektivt å intervenere i viktige determinanter av FA. For å gjøre dette er det nødvendig å framskaffe regionale og nasjonale data på objektivt målt FA og korrelater av FA for å følge utviklingen i helse og å initiere tiltak som skal øke FA.

Stikkord: Akselerometer, fysisk aktivitet, stillesittende tid, risikofaktorer for hjerte- karsykdom, kroppsmasse indeks, trender, korrelerer, voksne, tverrsnitt, longitudinal, Kan1, Statens helseundersøkelser

Summary

Introduction: Physical activity (PA) is important to maintain good health and prevent non-communicable diseases such as cardiovascular disease (CVD). However, low levels of PA are observed worldwide. Monitoring of CVD risk factors, objectively measured PA levels, and their correlates is important for surveillance and assessment of the effectiveness of interventions or public health initiatives aimed at increasing PA. Such data in the Norwegian population are needed, and because local cultural discrepancies may occur, regional data are important. Of particular interest is Sogn & Fjordane, a rural Norwegian county that was included in the National Health Screening Service (NHSS) in the mid-1970s due to its positive characteristics with respect to CVD morbidity, mortality, life expectancy and health behaviors.

Aim: The overall aims of this thesis were to increase our knowledge regarding the levels and trends in PA and CVD risk factors in adults in Sogn & Fjordane, to explore correlates of PA in this population, and where appropriate, to make comparisons with the rest of Norway.

Material and methods: This thesis is based on three separate studies; the Physical Activity among Adults and Older People Study in Sogn & Fjordane (Kan1S&Fj) in 2008-2010 (Paper I-IV), the NHSS study from 1975 to 1999 (Paper II and III) and the national Kan1 study in 2008-2010 (Paper II and IV). A sample of 622 40-42- and 53-55-year-olds (participation rate 61%) from Sogn & Fjordane is included in the cross-sectional study in Paper I. The repeated cross-sectional study in Paper II includes data from 375,682 40-42-year-olds (participation rate 94-32%) from Sogn & Fjordane and the rest of Norway. In the prospective observational study in Paper III, the health status and habits of 240 40-42-year-olds (participation rate 52%) from Sogn & Fjordane were followed after 13 years, whereas Paper IV is based on cross-sectional data from 972 40-42- and 53-55-year-olds (participation rate 40%) from Sogn & Fjordane and the rest of Norway. Physical activity was registered by self-reports (all studies) and objective measures (Kan1S&Fj and Kan1), whereas CVD risk factors and potential correlates of PA were registered through questionnaires and physical examinations (all studies).

Main results: Despite the significantly higher objectively measured PA level in Sogn & Fjordane compared to the rest of Norway (44% vs. 29% met the PA guidelines, $p<0.001$), the observed PA level is low. We found no sex differences in objectively measured overall PA level within the county, but significant sex differences were observed for sedentary time, light activity and moderate PA (Paper I).

Self-reported leisure time PA level has been relatively stable over a 35-year period, and no significant differences in trend were observed between Sogn & Fjordane and the rest of Norway (Paper II). Decreasing trends were observed in sedentary behavior (for women), moderate PA, smoking, systolic blood pressure (SBP), diastolic blood pressure (DBP), high-density lipoprotein-cholesterol (HDL-c) and total cholesterol (TC), whereas increasing trends were observed for sedentary behavior (for men), light PA (for women), vigorous PA, body mass index (BMI) and triglycerides (TG). Compared to the national trends, the 40-42-year-olds from Sogn & Fjordane had more beneficial trends in terms of TG, HDL-c and BMI but less beneficial trends in terms of SBP and DBP (Paper II).

Self-reported PA ($p<0.001$) and improved perceived health ($p=0.046$) were positively associated with objectively measured moderate-to-vigorous PA (MVPA) at follow-up, whereas BMI ($p=0.034$) and increased BMI ($p=0.014$) were negatively associated with MVPA at follow-up (Paper III). Objectively measured PA was positively associated with built environment factors such as perceived walkability, use of active transport and living in Sogn & Fjordane, whereas an inverse association was found with a community perception score describing the activity friendliness of their community (all $p\leq0.004$). Geographical differences in correlates between Sogn & Fjordane and the rest of Norway were observed for community perceptions and public transport for commuting (Paper IV).

Conclusions: This first epidemiological investigation of objectively measured PA and its correlates in adults in Sogn & Fjordane, show that this population has maintained more positive characteristics in terms of PA levels and several other CVD risk factors compared to the rest of Norway. However, from a public health perspective, the PA level is still insufficient, given the convincing evidence of the health benefits of PA for those who are sufficiently physically active. Therefore, it is now time to make PA a major target of public health education campaigns and policies and to effectively intervene in major determinants of PA. To do so, obtaining regional and national data on objectively measured PA and its correlates is essential to follow the development of health and to initialize and enforce initiatives aiming to increase PA level.

Key words: Accelerometers, physical activity, sedentary time, cardiovascular risk factors, body mass index, trends, correlates, adults, cross-sectional, longitudinal, Kan1, National Health Screening Service

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List of papers

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

I. Solbraa AK, Mamen A, Ylvisåker E, Resaland GK, Steene-Johannessen J, Holme IM, Anderssen SA. Level of physical activity, cardiorespiratory fitness and cardiovascular disease risk factors in a rural adult population in Sogn og Fjordane. Nor J Epidemiol. 2011;20(2):179-88.

II. Solbraa AK, Holme IM, Graff-Iversen S, Resaland GK, Aadland E, Anderssen SA. Physical activity and cardiovascular risk factors in a 40-42-year-old rural Norwegian population from 1975 – 2010: repeated cross-sectional surveys. BMC Public Health. 2014;14:569. DOI: 10.1186/1471-2458-14-569.

III. Solbraa AK, Ekelund U, Holme IM, Graff-Iversen S, Steene-Johannessen J, Aadland E, Anderssen SA. Long-term correlates of objectively measured physical activity and sedentary time in Norwegian men and women. (On request, revised and resubmitted to J Phys Act Health).

IV. Solbraa AK, Anderssen SA, Holme IM, Kolle E, Hansen BH, Ashe MC. The built environment correlates of objectively measured physical activity in Norwegian adults: a cross-sectional study. (Under review).

Abbrevations

BMI:	Body mass index
CHD:	Cardiovascular heart disease
CI:	Confidence interval
CONOR:	Cohort of Norway
CPM:	Counts per minute
CRF:	Cardiorespiratory fitness
CVD:	Cardiovascular disease
DBP:	Diastolic blood pressure
GIS:	Geographic Information Systems
HDL-c:	High-density lipoprotein-cholesterol
HUNT:	The North-Trøndelag Health Study
ICC:	Intraclass correlation
Kan1:	Physical Activity among Adults and Older People Study
Kan1S&Fj:	Physical Activity among Adults and Older People Study, supplementary survey in the county of Sogn & Fjordane
LDL-c:	Low-density lipoprotein-cholesterol
LPA:	Light physical activity
LTPA:	Leisure time physical activity
METs:	Metabolic equivalents
MPA:	Moderate physical activity
MVPA:	Moderate-to-vigorous physical activity
NCD:	Non-communicable disease
NHANES:	The National Health and Nutrition Examination Survey
NHSS:	National Health Screening Service
OR:	Odds ratio
PA:	Physical activity
QALYs:	Quality-adjusted life years
RER:	Respiratory exchange ratio
RPE:	Rating of perceived exertion
SBP:	Systolic blood pressure
SD:	Standard deviation
S&Fj:	Sogn & Fjordane
TC:	Total cholesterol
TG:	Triglyceride
VO_{2max}:	Maximal oxygen uptake
VPA:	Vigorous physical activity
WC:	Waist circumference
Δ:	Prefix for variables including change-scores

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1. Introduction

1.1 Public health and non-communicable diseases

Public health is defined as population health and the distribution of health in a population (1). Long life expectancy is important for public health (2), and the Norwegian government has set a goal to be among the three countries in the world with the highest life expectancy (3). However, improving public health means more than simply delaying death or increasing life expectancy (4, 5). People and societies are concerned about having sufficiently good health, i.e., the absence of disease and maintenance of function (4). In order to prevent disease, it is necessary to identify and address underlying health risks; however, such health risks often have their roots in a multifactorial chain of events over time (6). Social inequality, migration health, health behavior, mental health, dementia, injuries, accidents and violence are some health challenges (3). As a country develops, the types of diseases that affect a population typically shift from primarily infections to primarily non-communicable diseases (NCDs), such as cardiovascular diseases (CVDs), type 2 diabetes, cancer and chronic respiratory diseases (7, 8).

1.1.1 A historical perspective of screening of risk factors and health habits

To provide a historical perspective, as a result of major health problems with tuberculosis in Norway, a chest X-ray screening service was established in the 1940s (9). During the post-war years, this service covered the whole country. As tuberculosis decreased, screening of the entire population was gradually replaced by selective case-finding (9). Cardiovascular diseases increased dramatically in Northern Europe, including Norway, and the USA after the Second World War (10). In the 1970s, Norway had a high CVD mortality rate compared to the present rate, even in an international context (11), and large epidemiological surveys on CVD risk factors were included in the existing screening services. After a minor decrease in CVD mortality in Norway in the 1970s and 1980s, a substantial decrease has been seen in both sexes and all age groups since 1987 (10). The same pattern has been found for CVD morbidity (12), and currently Norway is a low-risk country, with the same levels of CVDs as Mediterranean countries (10). In the 1970s and 1980s, extensive surveys of risk factors for CVDs were carried out in three counties (the *County Study*), and in 1985 the *Age 40 Program* started, which became nation-wide in 1993 (9). All municipalities were visited every three years; at each wave of visits, all persons aged 40-42 were invited to participate in the study. The studies focused on surveillance, research, education and prevention through population-based and high-risk strategies. The County Study and the Age 40 Program will be referred to as the *National Health Screening Service (NHSS)* throughout this thesis.

Currently, in Norway public health conditions are very good (13). Norwegians have a high life expectancy and are ranked at the top of international comparisons of well-being and welfare (13). As CVD morbidity and mortality decreased, the same beneficial pattern has been observed for smoking (14-16), a health behavior strongly associated with CVD morbidity and mortality that has been a major target of public health education campaigns, politics and legislation over the last forty years (14, 15). However, physical activity (PA), a health behavior associated with CVD mortality as strongly as smoking (17), has not received the same level of public health attention during this period. It appears that a decrease in PA and an increase in sedentary time (i.e., any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents (METs) while in a sitting or reclining posture (18)) have occurred (19). Despite the decrease in CVD morbidity and mortality (10, 12), the prevalence of other NCDs and risk factors has increased (8, 20) and sedentary time involving prolonged sitting has become a prevalent feature of everyday living. Hence, the role of regular PA in the prevention of NCDs has been highlighted (20-23). This is emphasized by the recently observed increase in hospitalization due to acute myocardial infarction among persons under 45 years in Norway (24). Hence, monitoring PA levels and its correlates is important for surveillance and assessment of the effectiveness of interventions or public health initiatives aimed at increasing PA (2, 8, 25). Thus, the Norwegian Directorate of Health initiated a screening of objectively measured PA with the first screening of adults in 2008-2010, the *Physical Activity among Adults and Older People Study (Kan1)* (26, 27). The need for a monitoring system was emphasized in the Public Health Act of 2011 (1), which requires each single municipality to provide an overview of public health challenges. Of particular interest is the county of Sogn & Fjordane (referred to here as Sogn & Fjordane), which was included as one of three counties in the NHSS in the mid-1970s, as the county has been shown to have one of the best national outcomes with respect to CVD morbidity, mortality, life expectancy and health behavior (11, 28-30).

1.1.2 Life expectancy

Life expectancy is a long-term measure of the efficacy of public health work (2). In Norway, life expectancy at birth increased by 11 years in men and 12 years in women from 1970 to 2010 (31). In 2013, the life expectancy was 79.7 years for men and 83.6 years for women (13), whereas the highest life expectancy globally in 2012 was 81.2 years in Icelandic men and 87.0 years in Japanese women (32). This indicates variations in life expectancy across nations and cultures, and demographic studies have identified populations with a significantly higher prevalence of centenarians (33-37). Blue Zones (38) is an anthropological and demographic project that includes areas with a high life expectancy, such as Ikaria (Greece), Okinawa (Japan), Sardinia (Italy), Loma Linda (California, USA) and Nicoya (Costa Rica). In Norway, Sogn & Fjordane has had the longest-lived population for decades (30). The life expectancy was 79.8 years for men and 84.3 years for women from 2006-2012, slightly higher than the national average (30). Figure 1 displays life expectancy from 1971 to 2010 in Sogn & Fjordane and the rest of Norway.

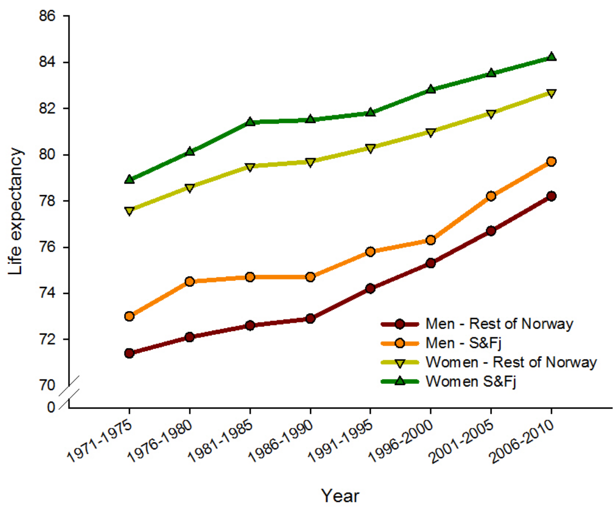

Figure 1. *Mean life expectancy stratified by sex in Sogn & Fjordane (S&Fj) and the rest of Norway (39).*

1.1.3 Health behavior

There is a consensus that life expectancy is affected by both genetic and environmental factors, however, it is still unclear which specific characteristics of the environment that may promote longevity (33). Prospective studies have observed that smoking, high consumption of alcohol, low consumption of fruits and vegetables and low levels of PA are associated, both independently and together, with an increased risk of premature mortality (40). Worldwide, physical inactivity (i.e., not meeting recommended guidelines for PA (18)) is estimated to cause 6-10% of the major NCDs and 9% of premature deaths (20). This makes inactivity similar to the established risk factors of smoking and obesity, in terms of risk of NCDs. Importantly, the elimination of physical inactivity worldwide is expected to increase life expectancy by 0.68 years (20). Because all the gain accrues to people who move from inactive to active, the increase in life expectancy in the inactive group alone is greater (20). To put this in perspective, it has been estimated that 50-year-olds in the USA would gain 1.3-3.7 years by becoming active (41), whereas quitting smoking at age 50 has been estimated to increase life expectancy by 2.3-2.5 years (42). In the Oslo study, which examined health habits in 1972-73 and in 2000, similar effects on mortality were found for smoking and PA (17). A change from inactive to active (i.e. meeting recommended guidelines for PA) for 40-49 year olds is estimated to add 6.0 quality-adjusted life years (QALYs) (95% confidence intervals (CI): 1.66 to 10.37) (43). Blue Zones suggests some common characteristics across the populations with high life expectancy; natural movement, a healthy diet (moderate portions, vegetarian/Mediterranean diet) and psychosocial factors such as having routines to prevent stress, knowing your purpose in life and having a healthy social network (38). Successful aging is multidimensional and has been subject of discussion and research throughout time (44, 45). In 44 BC, Cicero gave the recipe for successful aging in two words: "Be active" (46). Given the strong evidence for the health benefits of PA, including reduced rates of all-cause mortality and CVDs (20), PA will be the main focus of this thesis.

1.2 Sogn & Fjordane

Sogn & Fjordane has a population of approximately 110,000 inhabitants as of 2014 (47). People mainly live in small urban areas or are scattered over a wide area. The population density for the region is 5.9 inhabitants/km^2 compared to 13.2 inhabitants/km^2 throughout Norway (47), whereas the population density in, for instance, England is 407 inhabitants/km^2 (48). Although the county is dominated by the fjord landscape and mountainsides, there are also varying degrees of urbanization. Furthermore, the divorce rate (49), education level (30, 50) and unemployment rates (51) are lower than in the rest of Norway. Moreover, Sogn & Fjordane has a considerably lower prevalence of mental disorders compared to Oslo, the capital of Norway, although the pattern is similar (52). The lifestyle of the population has been characterized by moderation and adherence to traditional values (52), i.e., the divorce rate, consumption of alcohol and criminality rate has been low compared to other regions of Norway (53).

1.2.1 History of cardiovascular health and health behavior in Sogn & Fjordane

The NHSS study of the mid-1970s showed that Sogn & Fjordane had relatively low levels of myocardial infarction risk and the lowest CVD mortality rate in Norway (11). The county maintained one of the lowest levels of infarct risk in the country until the late 1990s (28, 29). Recent public health statistics still suggest a healthy population (54). However, in 2012 Sogn & Fjordane had 234 (men) and 154 (woman) deaths caused by CVDs among every 100 000 persons compared to 228 (men) and 142 (woman) nationally (Figure 2) (30).

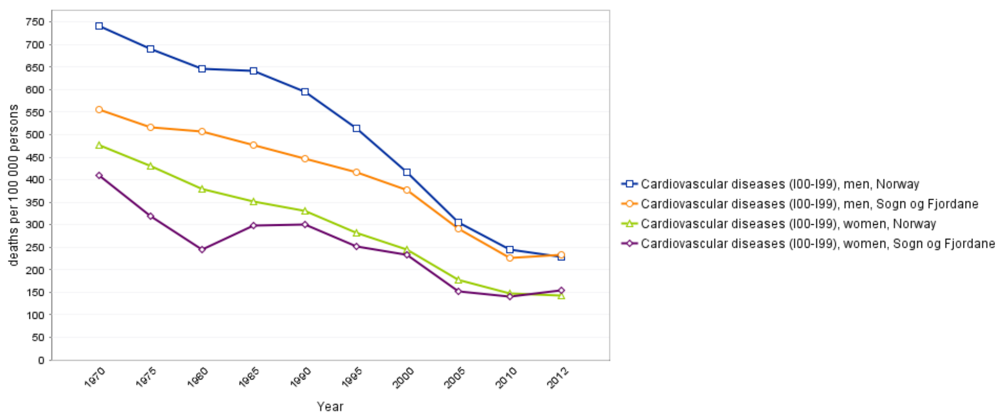

Figure 2. *Cardiovascular mortality stratified by sex in Sogn & Fjordane and the rest of Norway (30).*

Since the first study of self-reported PA levels in adults in the mid-1970s, Sogn & Fjordane has had higher levels of PA and lower levels of physical inactivity compared with the rest of the country (11, 29, 54, 55). For example, the proportion of physically inactive people (here defined as light PA (LPA) less than two hours per week) was 12% in 1993 compared to 19% in the rest of Norway (29). Smoking has been somewhat less common in Sogn & Fjordane with 38% of the population being smokers in 1993 compared to 42% in the rest of Norway (29). Lower body mass index (BMI) has been found among men and women in Sogn & Fjordane compared to other counties (29).

1.3 Cardiovascular disease risk factors

Cancer and CVDs are the most common causes of death for men and women, both nationally and globally (10, 30, 56). The two most common fatal CVDs are coronary heart disease (CHD) and stroke (10, 12, 56). Overweight and obesity (10, 56, 57), hypertension, high levels of lipids, smoking, psychosocial factors, socioeconomic status (10, 56), heredity (10), insufficient PA (56, 58), type 2 diabetes, unhealthy diet, alcohol abuse (56) and low physical fitness (58, 59) are some of the risk factors for CVDs. According to the World Health Organization, the eight risk factors of alcohol and tobacco use, high blood pressure, high BMI, high cholesterol, high blood glucose, low fruit and vegetable intake and physical inactivity account for 61% of CVD mortality (6). The INTERHEART study found that the nine risk factors of smoking, increased apolipoproteins, history of hypertension, diabetes, abdominal obesity, psychosocial factors, daily consumption of fruits and vegetables, regular alcohol consumption and regular PA accounted for 90% of the population-attributable risk for myocardial infarction in men and 94% in women (60). These risk factors are associated with CVDs in different ways (Figure 3), and the total CVD risk is determined by the combined effect of these risk factors, which commonly coexist and act synergistically (61). Unhealthy behaviors, determined by multifactorial causes, may lead to intermediary risk factors such as metabolic and physiological changes and/or act as a direct cause of a disease (6, 56). Long-term population studies have provided knowledge about levels and trends of CVD risk factors, both nationally (16, 29, 55, 62-64) and internationally (65). In the following passages, an overview of the level and trends of risk factors will be provided.

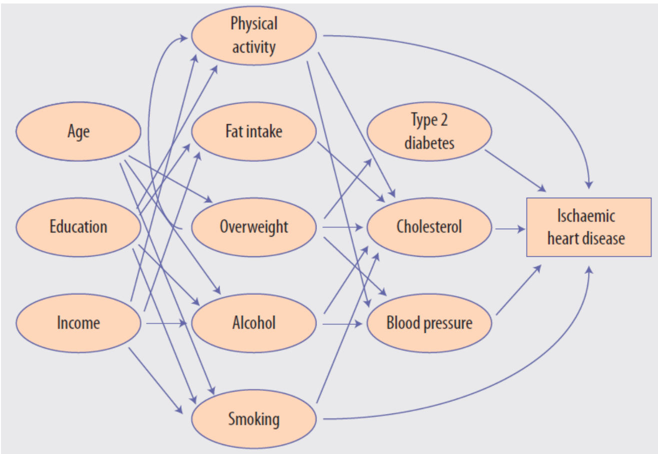

Figure 3. *Cardiovascular risk factors and their effect on ischemic heart disease (6).*

Physical activity. Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure (66). A substantial body of literature highlights the benefits of regular PA in the prevention of NCDs (21, 22, 58, 59, 67-71) and its association with increased longevity (58, 59). Physical inactivity is ranged as the fourth leading contributing factor to death globally (6). Due to the health benefits achieved by regular PA, health-enhancing PA guidelines have been issued both nationally (72) and internationally (21, 22, 73). The current guidelines recommend that adults engage in at least 150 minutes of moderate-intensity PA (MPA) or in at least 75 minutes of vigorous-intensity PA (VPA) throughout the week or a combination of the two spread out over most days during the week (72). Adherence to the PA guidelines has been associated with a lower risk of death (74). Although there is a paucity of objective data on sedentary time from prospective observational studies, recent studies have also suggested sedentary time as a population-wide, ubiquitous health risk that may be independent of leisure time PA (LTPA) (75-79). Despite the controversies surrounding this hypothesis, a reduction in sedentary time is now also included in the current guidelines, as reduced sitting will increase overall activity (72).

Inconsistent results have been observed in studies investigating trends in LTPA (16, 19, 80, 81). Most international studies have found an increase in LTPA (80, 82-84), whereas others have found a decrease (81). Inconsistency is also found in Norwegian studies; some (16, 85, 86) have found an increase in LTPA, whereas others (87, 88) have found a decrease. Consistency is more apparent in studies investigating occupational PA, where decreases have been observed (16, 80, 82, 84, 89, 90). Few studies have looked at active transport, and those that have are inconsistent (80, 82). Conflicting conclusions have been reached when investigating levels of PA in Norway (27, 85, 87, 91). For instance, 68% of Norwegians view themselves as physically active (92), and 33% to 61% report participation in PA at least twice a week (85).

Overweight and obesity. The rising prevalence of overweight and obesity has been described as a global pandemic (93, 94). Overweight, defined as a BMI between 25.0 kg/m^2 and 29.9 kg/m^2, and obesity, defined as a BMI from 30.0 kg/m^2 and above (95), are both important risk factors for CVD morbidity and mortality (6, 8, 96). Waist circumference (WC) has been suggested as more precise predictors of CVDs (57). However, most previous studies have used BMI, and other studies have found similarly strong associations among BMI, WC, and CVD risk (95). Although multiple plausible causes of obesity have been posited (97), the core reason for increased body weight is that the amount of calories consumed is greater than the amount of calories expended. Thus, relative levels of PA and energy intake are "the big two" factors that directly cause overweight and obesity (97).

An increase in BMI has been observed in all segments of the population during recent decades, both in Norway (16, 62-64, 98) and in most other Western countries (93, 99-101). Worldwide, the prevalence of overweight and obesity combined rose by 27.5% for adults between 1980 and 2013 (94). In Norway, the trend has been slightly different for men and women. Men have had a steady increase, whereas a decrease was observed in women in the late 1970s, followed by an increase in the 1990s (102). By 2006-2008, 61% of Norwegian women and 75% of men were overweight or obese (BMI $\geq$25.0 kg/m^2) (63). Recent studies have indicated a possible slowing of the obesity epidemic internationally (65, 94). In Norway, a plateau in the proportion of overweight people has been observed, but no halt is observed in BMI or WC (63).

Smoking. Health risks from tobacco use are caused by the direct consumption of tobacco as well as exposure to second-hand smoke (56). Smoking accounts for close to 10% of all CVDs globally and is ranked as the second leading risk factor for all-cause mortality, behind high blood pressure (6). However, smoking is ranked as the leading risk factor in high-income countries (6). Prospective cohort studies provides a large body of evidence regarding the beneficial effects of smoking cessation on CHD mortality (61). Compared to those who continue smoking, people who stop smoking at 30, 40 or 50 years of age gain approximately 10, 9 and 6 years of life expectancy, respectively (103).

The rate of smoking among men decreased from 65% in 1960 to 25% in 2000 (14). After a peak in 1965-1975, the proportion of female smokers was a bit above 30% and remained stable until the beginning of the 1990s, when it decreased (14, 16, 98). A decrease in smoking from the 1970s to 2000 was also observed in the USA for both sexes (15). Men had a steady decline during the entire period, whereas women had a minor increase in the mid-1970s (15). As of 2013, 15% of Norwegian men and 14% of women smoked (104). An inverse relationship has been observed between income level and prevalence of tobacco use (56).

Hypertension. Elevations in blood pressure change arterial structure (105). Hypertension is defined as a systolic blood pressure (SBP) above 140 mmHg and a diastolic blood pressure (DBP) above 90 mmHg (grade 1) (10, 105). Fifty-one percent of all deaths caused by stroke and 45% of all deaths caused by CHD can be attributed to hypertension, and it is globally ranked as the leading risk factor for both all-cause and CVD mortality (6).

Both SBP and DBP have decreased in Norway (86, 98) and in the majority of other Western countries (106). In three counties in Norway, mean SBP decreased in 40-year-olds from 135 mmHg in 1972-74 to below 130 mmHg in 2000-02 (98). However, in 2002-2003, 40-50% of all 60-year-olds living in the counties Oslo, Hedemark, Oppland, Troms and Finnmark had hypertension (SBP ≥140 mmHg and/or DBP ≥90 mmHg) (107). The corresponding level in the North-Trøndelag Health study (HUNT) population in 2006-2008 was 26% in women and 34% in men (86).

Lipids. Total serum cholesterol (TC) has long been considered as a crucial independent risk factor for CVDs, especially in younger individuals (61). However, recent research has found that TC is an overestimated risk factor (108), and levels of low-density lipoprotein-cholesterol (LDL-c) and high-density lipoprotein-cholesterol (HDL-c) have been found to be more important for health than TC (6). Nevertheless, the risk of elevated TC is often cited given the available information (6). Increased blood cholesterol increases the risk of CHD, stroke and other vascular diseases; globally, one-third of all CHDs are caused by high levels of cholesterol (6). Unhealthy levels of lipids are defined as TC >5.0 mmol/l, LDL-c >3,0 mmol/l, HDL-c ≤1.00 mmol/l (for men) and ≤1.30 mmol/l (for women) and triglycerides (TG) >1.7 mmol/l (10).

TC levels have decreased substantially in Norway (86, 98) and in the majority of other Western countries (109). In the counties of Oppland and Oslo, mean TC level decreased 0.5-0.6 mmol/l from 1972-74 to 2000-02 in 40-year-olds (98). However, in 2002-2003, 80-87% of all 60-year-olds living in Oslo, Hedemark, Oppland, Troms and Finnmark had TC levels above the recommended level of 5.5 mmol/l (107). In the HUNT study, the proportion of the population with a TC ≤5.0 mmol/l increased from 24% to 32% in women and from 23% to 34% in men from 1995-1997 to 2006-2008 (86).

1.4 Correlates and determinants of physical activity and sedentary time

Both in Norway (27) and globally (19, 110, 111), the majority of the population do not obtain sufficient PA to maintain good health. Understanding why some people are more physically active than others is essential for developing public health interventions aimed at increasing PA and decreasing sedentary time (112). Correlates describe factors associated with activity but do not provide evidence of a causal relationship between these factors and PA (112, 113). Furthermore, determinants, identified by longitudinal observational studies and experimental data, identify factors that have a causal association with PA (112, 113). Because PA is affected by multiple levels of influences, behavioral theories based on an ecological model (including relationships between individuals and their social and physical environments) are believed to provide comprehensive frameworks for understanding the determinants of the activity (114). Previous studies have suggested educational level (112, 115, 116), health status (112, 115), intention to change behavior (112, 116-118), PA earlier in life (112, 115-117, 119), sex, BMI, smoking (116, 119, 120), psychosocial factors (112, 118) and built environment (112, 121-124) as correlates or determinants of PA. However, most studies have used cross-sectional designs, and prospective observational studies examining the association between the correlates and objectively measured PA and sedentary time are scarce (25, 112, 115, 116). Moreover, most previous research has usually considered LTPA, which may constitute a small part of overall PA level (112, 116).

Demographic. Age and sex are the two demographic correlates that are most consistently related to PA in adults in the literature (112, 115, 116). Internationally, PA participation has been found to be consistently higher in men than in women and is inversely associated with age (112, 116, 119). However, more recent studies of objectively measured PA have not observed any sex gradient in overall PA (111, 125). Socioeconomic status, occupational status, and educational attainment have also been found to be associated with PA, particularly LTPA (112, 115, 116, 126). However, higher levels of total PA appear to be associated with having a lower-status occupation (126). An inverse association has also been found for job strain, working hours and overtime in relation to LTPA (126).

Biological. Health status is one of the clearest determinants for PA in adults (112, 115, 119). Overweight and obesity have a negative association with PA (112, 115, 116, 125); however, this association is most likely bi-directorial, because habitual PA across the life span is associated with lower weight gain (127).

Psychological. With respect to mental health, several well-known determinants have been confirmed to be associated with PA (118). Self-efficacy (112, 118) appears to be among the most intensively studied and consistent determinants of PA. Perceived behavioral control has been suggested as a determinant, whereas the associations are weaker for outcome expectations and perceived benefits (118). Mixed results have been found with respect to psychological characteristics in association to PA (112, 118).

Behavioral. Past exercise behavior (112, 115, 116, 119) and intention to exercise (112) have been found to be determinants of PA. Dietary habits (116) have been found to be positively associated with PA, whereas being a smoker has been found to be inversely associated with PA (115, 116, 119, 125).

Built environment. Although findings are inconsistent across studies (112), built environments that are designed to provide accessible, attractive, and convenient locales have been suggested to positively influence PA behaviors (112, 121-124, 128). Factors such as access to key destinations (e.g., shops, services, work etc.), traffic safety, degree of urbanization (population density or size of municipality) and quality of the environment (general activity-friendliness) are associated with total PA (112, 122-124). Most studies have been cross-sectional, although van Stralen et al. identified recreational facilities, transportation and the social environment as determinants (118). However, the built environment may vary from country to country and may be cultural and locally determined (124). To our knowledge, there are few (125) studies that examine the association between objectively measured PA and the built environment features in Norway. There is great variability in the geographic and built environment features within Norway, but no study has assessed regional variations. Hence, understanding which features of the built environment provide active living opportunities in a sample of the Norwegian population is crucial for promoting PA.

1.5 Assessment of physical activity

Physical activity is multidimensional and accurate assessment is a challenging task because of the complexity of the behavior. Study type and design has an important influence on the choice of method to measure PA (25, 129). Assessments of PA in population-based studies have mainly been based upon subjective methods, such as self-administered questionnaires (25, 87, 89, 130-132). They are the cheapest and easiest way to collect PA data from a large number of people in a short time, and they provide assessment of PA by domains (25). However, self-reported instruments have numerous limitations with respect to difficulties in ascertaining the frequency, duration and intensity of PA, capturing all domains of PA, and accounting for social desirability bias, recall bias and reactivity (25, 130, 133). Methodological weaknesses and poor assessment methods might partly explain the conflicting observations with respect to PA levels (25). Due to these limitations, objective assessment instruments, such as accelerometers, have been introduced to quantify PA (25, 134). Accelerometers measure body acceleration and are able to provide more detailed information on PA patters and intensity (25). They are less prone to bias compared to self-reported measures and have been used in large population-based studies (25, 27, 110, 135, 136). However, accelerometers have known limitations in assessing PA during specific types of activities, and data reduction challenges do exist (137). The agreements between self-reported and accelerometer-measured PA are poor, and their correlation coefficients are low (between 0.20 and 0.46) (138, 139).

1.6 Need for new information

Despite the recent decrease in CVD morbidity and mortality (10, 12), CVDs are still among the most common causes of death (10, 12, 30, 56). Together with the substantial increase in other NCDs (8, 20) and the low levels of PA (27, 110, 111), this emphasize the importance of knowledge of PA level and CVD risk factors (1, 19, 26). In addition, structural changes in the environment have occurred. In 2009, 59% of travels of 1-3 kilometers were taken by car (140), and sedentary time, involving prolonged sitting, has become a prevalent feature of everyday living (141). This underlines the importance of understanding built environment features together with other correlates, and the relation of these factors to PA.

Nationally, repeated population surveys have provided knowledge about levels of and trends in self-reported PA and CVD risk factors (16, 29, 55, 62-64). Although self-reported PA is a feasible method that may provide useful information about PA levels, it is related to a number of methodological limitations (25, 130, 133). Objective data on PA measures in Norway are therefore needed. Furthermore, levels of PA, CVD risk factors and correlates of PA may vary from country to country and may be cultural and locally determined (11, 28-30, 124). Together with the required overview of the public health challenges in each single municipality (1), this illustrates the need for regional data.

Most studies examining the association between correlates of objectively measured PA and sedentary time have used cross-sectional designs (25, 112, 115, 116); thus, there is a need for prospective observational studies investigating these associations. Additionally, recent cross-sectional studies investigating trends in PA and CVD risk factors in Sogn & Fjordane is lacking (29), and there is a need for objective measures of PA as a basis for future secular trend and longitudinal studies. Hence, the focus of this thesis are trends and levels in PA and CVD risk factors (Paper I-II) and correlates associated with why some people are more active than others (Paper III-IV).

The aims of the present thesis were as follows:

I. To describe levels of objectively measured physical activity, directly measured cardiorespiratory fitness (CRF) and cardiovascular disease risk factors in an adult population in Sogn & Fjordane (**Paper I**).

II. To examining the secular trends in self-reported leisure time physical activity and other cardiovascular disease risk factors over a 35-year period in a 40- to 42-year-old healthy rural population in western Norway and to compare these trends with national trends over the same time period (**Paper II**).

III. To examining 1) the associations between a set of characteristics (demographic, biological, psychological and behavioral) and objectively measured physical activity and sedentary time at 13 year follow-up, and 2) the association between changes in these characteristics over time and physical activity and sedentary time at follow-up **(Paper III**).

IV. To examining perceived features of the built environment, to characterize their associations with objectively measured physical activity levels in adults, and to examining differences in these correlates between Sogn & Fjordane and the rest of Norway (**Paper IV**).

2. Materials and methods

Based on the long term healthy population in Sogn & Fjordane, the Kan1S&Fj study was carried out as a supplementary survey to the Kan1. This thesis is based on three separate studies: the NHSS study (comprising the County Study and The Age 40 Program) (29, 142), the Kan1 study (27) and the Kan1S&Fj study (see Figure 4).

2.1 Study design and participants

The NHSS study. The NHSS study gathered data on CVD risk factors in 40-42-year-olds (11). The data were gathered using questionnaires and physical examinations. The participants were invited to a health screening, and health behavior, perceived health and education level were collected by a survey questionnaire. The examinations included weight, height and blood pressure measurements and blood sample collections. The surveys were administered by the NHSS mobile teams (29) and included seven cohorts (1975, 1980, 1985, 1990, 1993, 1996 and 1999) in Sogn & Fjordane and in the rest of Norway. The dataset (n=375,130) includes data from all 26 municipalities in Sogn & Fjordane (n=21,039) and data from the other 18 counties in Norway (n=354,091) (Figure 4). Data on 40-42-year-olds from all cohorts were included in the repeated cross-sectional study in Paper II, whereas data from the 1996 cohort in Sogn & Fjordane was included as baseline data in the longitudinal observational study in Paper III.

The Kan1 and the Kan1S&Fj study. Kan1 was a multicenter study involving ten regional test centers throughout Norway (2008-2010). An additional sample was included in Sogn & Fjordane in the Kan1S&Fj. In both studies, invitations were sent via mail; as a reminder in the case of no response, the subjects were contacted by phone and/or mail. The studies were divided into two phases. When signed informed consent was received, a questionnaire and an accelerometer to measure PA were sent to the participants via mail and returned after use in a prepaid envelope. The questionnaire covered health behavior, weight, height, potential correlates of PA and educational level. In phase two, a randomly selected 1/3 of the participants attended a physical examination at which CRF and CVD risk factors were measured (blood samples were only obtained in Kan1S&Fj). Tests were performed in nine test centers throughout Norway, as one of the original test centers did not participate in phase two.

In the Kan1S&Fj study, all 40-42- and 53-55-year-olds in three geographically close municipalities (Luster, Sogndal and Leikanger) were invited to participate (n=1096) (Figure 4). The dataset from phase one includes 628 participants. Of those providing valid accelerometer and questionnaire data, 400 persons were invited to attend a physical examination. In total, 218 participants provided physical examination data. Data from this study are included in the cross-sectional studies in Paper I and IV (both age groups), the repeated cross-sectional study in Paper II (the 40-42-year-old group), and as follow-up data in the longitudinal observational study in Paper III (the 53-55-year-old group). Also included in the study sample is a representative sample of 1366 40-42- and 53-55-year-olds from 12 out of 19 counties in Norway, who were drawn from the Norwegian population registry and invited to participate in the Kan1 study (27). The Kan1 sample includes 505 participants and data from this study are included in Paper II (the 40-42-year-old group) and Paper IV (both age groups). The number of participants in Paper I-IV may differ from the number of participants described in the NHSS study, the Kan1 study and the Kan1S&Fj study, due to the inclusion of different variables in the respective papers.

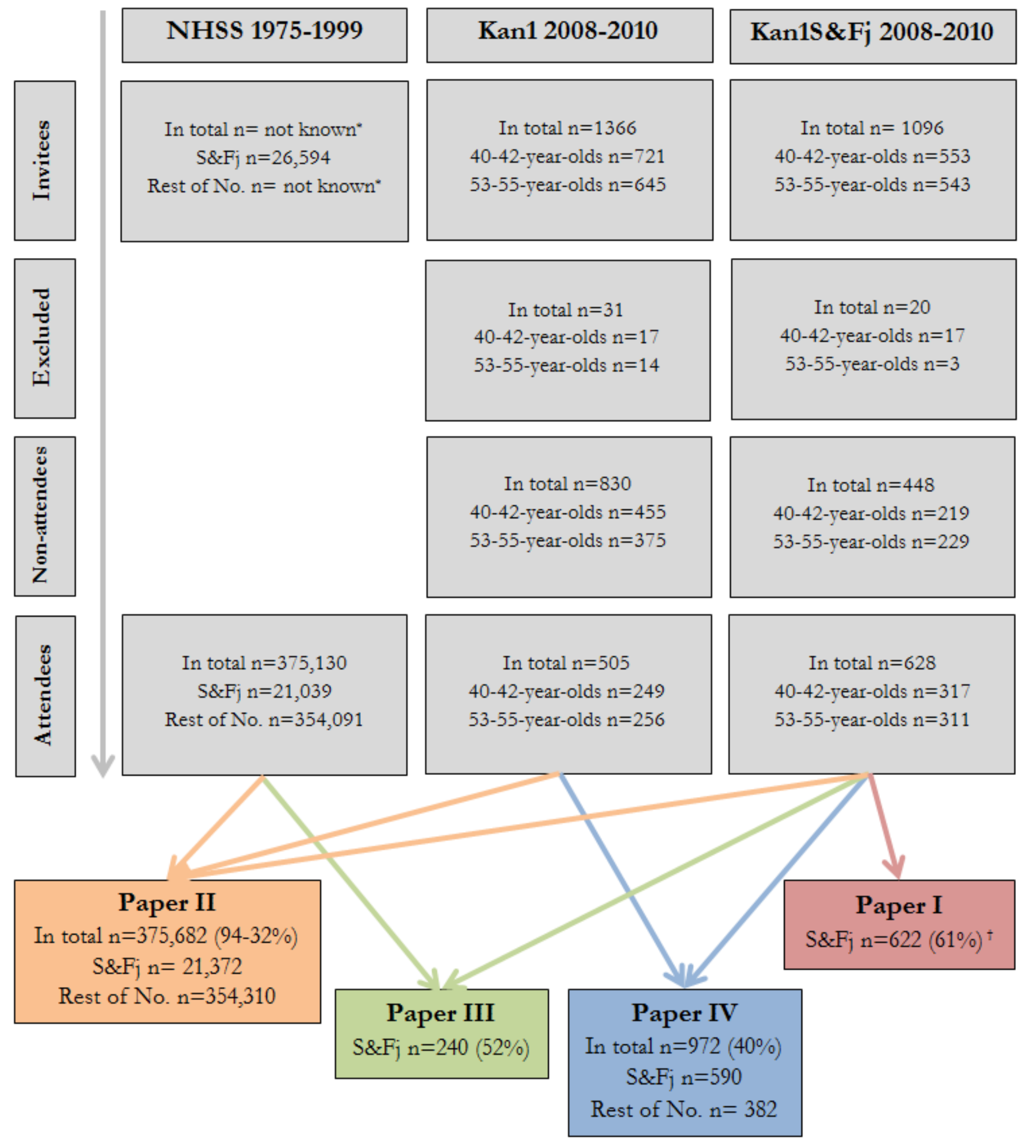

Figure 4. *Flow chart of invitees, excluded, non-attendees and the study populations in Paper I-IV.*

**Information about invitees in the National Health Screening Service (NHSS) study is incomplete.*
†The participation rate in Paper I was calculated less rigorous compared to the other papers with respect to who was defined as excluded. The more rigorous calculation corresponds to a participation rate of 58% in Paper II.
S&Fj, Sogn & Fjordane; Rest of No., Rest of Norway.

2.2 Ethics

The study was approved by the Regional Committee for Medical Research Ethics, the Norwegian Social Science Data Services AS and the Norwegian Tax Department (Appendix I). The Norwegian Institute of Public Health has given their approval to use the data from the NHSS study (Paper II and III) (Appendix I). The participants in Kan1 and Kan1S&Fj provided written informed consent and a health status declaration prior to testing (Appendix II). A selected sample of the participants in the Kan1S&Fj study was asked to provide consent to link their data to previously collected baseline data from the NHSS study (Paper III) (Appendix II).

2.3 Measurements

2.3.1 Physical activity measurements

Subjective measurements. In all NHSS cohorts, except for 1996, and in the Kan1 and Kan1S&Fj study, LTPA was self-reported using the Gothenburg instrument (143-145) (Appendix III). The participants were asked to rank their average LTPA level into one of four different categories (143, 144, 146), which were later classified as: 1) sedentary behavior, 2) LPA, 3) MPA and 4) VPA. In the NHSS cohort in 1996, as well as in the Kan1 and Kan1S&Fj studies, PA was assessed by the CONOR instrument, which asked for a weekly average of PA during leisure time over the last year (Appendix III). The duration was quantified on a four-category scale (none, <1 hours, 1-2 hours and ≥3 hours per week) for light activity and vigorous PA (145, 146). Physical activity was categorized into 1) light, 2) moderate and 3) vigorous PA. The CONOR instrument has previously been used in several Norwegian surveys, including the large Cohort of Norway (CONOR) and discriminates well (145-147). For more details regarding the subjective measures, see the methods sections of Paper II and III.

Objective measurements. In the Kan1 and Kan1S&Fj study, PA level was measured objectively with the ActiGraph GT1M accelerometer (ActiGraph, LLC, Pensacola, Florida, USA). The accelerometer was initialized and downloaded by the software program ActiLife (ActiGraph, Pensacola, Florida, USA). The participants were instructed to wear the monitor above the right hip during all waking hours for seven consecutive days (Appendix IV). An SAS-based program (SAS-Institute Inc, Cary, North Carolina, USA), CSA Analyser (csa.svenssonspork.dk), was used for accelerometer data processing. Physical activity level is presented as overall PA level (mean counts per minute, cpm), sedentary time (min/day <100 cpm), LPA (min/day, 100-2019 cpm), MPA (min/day, 2020-5998 cpm), VPA (min/day, ≥5999 cpm) and the combined measure of moderate-to-vigorous PA (MVPA, min/day, ≥2020) (148). In Paper I, <100 cpm was classified as inactivity instead of sedentary time. The proportion of the participants meeting the Norwegian PA guidelines (72, 149) was examined. The guidelines changed in 2014 (72), and data according to the previous guidelines are presented in Paper I, whereas supplementary analyses according to the current guidelines are presented in this thesis. For more details regarding the objective measures, see the methods sections of Paper I, III and IV.

2.3.2 Cardiorespiratory fitness

For participants participating in the second phase of Kan1S&Fj, maximal oxygen uptake (VO_{2max}) was determined by a progressive treadmill protocol to exhaustion, using a Woodway PPS 55 treadmill (Woodway GmbH, Weihlam Rhine, Germany) and a Moxus metabolic analyzer (AEI Technologies, Inc. Naperville, IL, USA) with accompanying software (Max II). A modified Balke protocol was used (150). Before testing, a Polar heart rate monitor (Polar OY, Kempele, Finland) was fitted to the chest by an elastic strap. To collect expired air, a Hans Rudolph Vmask (Hans Rudolph Inc, Kansas City, MO, USA), was attached to a Hans Rudolph two-way non-rebreathable valve (HR 2700), fitted onto the participants, controlled for air tightness and connected to the metabolic analyzer. The Borg rating of perceived exertion (RPE) was recorded at the end of the test. If the Borg RPE was ≥17 and/or RER (respiratory exchange ratio) was ≥1.10, the test was accepted as maximal (151). Cardiorespiratory fitness was also tested by the same protocol at the other test centers in Kan1, and VO_{2max} was adjusted by a correction factor to account for differences between analyzers between the test centers (151). For a more detailed description of the CRF test, see Paper I.

2.3.3 Anthropometry

In the NHSS study, weight and height were measured according to standard procedures to the nearest 0.5 kg and 1 cm (28, 152). In the Kan1 and Kan1S&Fj study, weight and height were self-reported for all participants through a questionnaire in phase one (Appendix III). In phase two, weight and height were measured to the nearest 0.1 kg and 0.5 cm, respectively. Body mass index was calculated as weight (kg) divided by height squared (m^2). Tests of agreement (Bland Altman plot and intraclass correlation (ICC)) between the self-reported and measured anthropometric measurements in Kan1S&Fj were performed (153). The plots showed individual differences between self-reported and measured BMI (95% limits of agreement: -3.28, 1.98 (ICC=0.952) for women and -2.28, 2.14 (ICC=0.953) for men). The mean difference (standard deviation, SD) between self-reported and measured BMI was -0.65 (1.34) kg/m^2 ($p<0.001$) for women and -0.07 (1.13) kg/m^2 ($p=0.604$) for men. Adjusting for the measurement method yielded results similar to the non-adjusted associations (data not shown); thus, self-reported BMI was included in the analysis when measured anthropometry was unavailable. The change in BMI was calculated as follow-up minus baseline data in Paper III. Furthermore, in phase two, WC was measured by anthropometric tape at the midpoint between the lowest rib and iliac crest after normal expiration. The mean value of the three measurements was used in the statistical analyses (Paper I).

2.3.4 Tobacco use

In all of the studies, a questionnaire was used to record self-reported smoking habits in three categories: 1) smokes, 2) does not smoke and 3) smoked earlier (used in Paper I) (Appendix III). The data were later dichotomized into 1) smoker and 2) non-smoker (Paper II and III). Changes in smoking habits were categorized into 1) quit smoking, 2) never smoked, 3) still smokes and 4) began smoking (Paper III).

2.3.5 Blood pressure measurements

In the NHSS study (Paper II) in 1975 and 1980, SBP and DBP were measured manually using the mercury method (Erkameter, ERKA, Kallmeyer Medizintechnik GmbH & Co.KG, Bad Tölz, Germany). Measurements were taken twice, with a one-minute interval between the measurements (154). In the 1985-1999 cohorts, the measurements were taken automatically using a Dinamap blood pressure monitor (Critikon Cooperation, Tampa, Florida, USA) (155). In Kan1 (Paper II), SBP and DBP were measured for the participants in phase two using a manual sphygmomanometer (Big Ben, Reister, Junginen, Germany) (151), whereas in Kan1S&Fj (Paper I and II) an automatic Omron HEM-907 blood pressure monitor (Omron Healthcare, Inc, Vernon Hills, IL, US) was used. The participants rested for five minutes, and a cuff of the appropriate size was placed on the left upper arm. From 1985 onward, three repeated measurements were taken at one-minute intervals (155). The mean value of the two last measurements was used in the statistical analyses. The validations of the Erkameter and the Dinamap have been described elsewhere (154). To investigate the agreement between the two automatic blood pressure instruments (Dinamap and Omron) and between the two blood pressure instruments used in 2010 (Omron and Big Ben), tests of agreement (Bland Altman plot and ICC) were performed (n=31) (153). The Dinamap device was borrowed from the Vestre Viken Hospital Trust. Between the Dinamap and the Omron device, the 95% limits of agreement were -12.12, 13.79 (ICC=0.901) for SBP and -11.27, 8.95 (ICC=0.853) for DBP. The mean difference (SD) between the devices were 0.82 (6.60) mmHg ($p=0.490$) for SBP and -1.16 (5.16) mmHg ($p=0.220$) for DBP. Between the Omron and the Big Ben devices, the 95% limits of agreement were -4.40, 10.78 (ICC=0.939) for SBP and -5.36, 6.80 (ICC=0.942) for DBP. The mean differences (SD) between the devices were 3.19 (3.87) mmHg ($p<0.001$) for SBP and 0.72 (3.10) mmHg ($p=0.217$) for DBP. A correction for the instrument used was performed in the analyses.

2.3.6 Blood samples

Non-fasting intravenous blood-samples were taken from the antecubital vein for participants in the NHSS study (Paper II) and the Kan1S&Fj study, phase two (Paper I and II). The samples were centrifuged immediately and sent to the Department of Medical Biochemistry at Oslo University Hospital, Ullevaal, Norway. Total cholesterol, TG (in all cohorts), HDL-c, and glucose (only in 1980-2010) were measured in serum using the Cobas Integra 800 analyzer from Roche (F. Hoffmann-La Roche Ltd, Basle, Switzerland) (29). Low density lipoprotein-cholesterol was estimated from TC, HDL-c and TG by the Friedewald formula (156).

2.3.7 Education level

In the NHSS study, highest completed education level was assessed using a five-category scale (29) (Appendix III) and later categorized into the same four categories as were used in Kan1 and Kan1S&Fj: 1) less than high school, 2) high school, 3) college or university ≤4 years and 4) college or university ≥4 years (used in Paper I, III and IV). In Paper II, education was dichotomized as 1) high school or less or 2) college or university. In Paper III, changes in education level from baseline to follow-up were calculated.

2.3.8 Perceived health

In the NHSS study, perceived health (later categorized as very good, good, poor/not so good), musculoskeletal pain and stiffness and psychological complaints were assessed by a questionnaire (Appendix III) (Paper III). Due to the highly correlated psychological complaints variables, a latent variable was created using categorical principal component analysis (157). In addition, perceived health was assessed in the Kan1 and Kan1S&Fj, and changes in perceived health from baseline to follow-up were categorized into 1) perceived improvement, 2) no change and 3) perceived worsening (Paper III).

2.3.9 Built environment

The inclusion of built environmental correlates (Paper IV) was guided by the empirical literature on environmental factors associated with PA in various settings and populations (Appendix III) (123, 158). The size of the home municipality (number of residents) was self-reported, and the location of residence was recorded. Community perceptions were measured with a seven-item measure. The participants indicated on a four-point Likert scale the extent to which they agreed or disagreed with statements describing their community, ranging from strongly disagree to strongly agree. The statements related to the safety of recreation areas/parks, access to PA facilities/places, organized offers for PA, access to shops, walking/biking facilities, pedestrian street safety and crosswalks and the presence of light signals making it easier to cross the road (125). The measures showed good internal consistency (α=0.79). A community perception score was calculated by the mean of at least six out of seven items. Perceived walkability was measured with a four-item measure, where participants indicated walking time from home to the grocery store, a recreational area/park/trail, a gym/swimming pool/sport center/outdoor sport facility and a forest/open field/mountain. A perceived walkability score was calculated by the mean of at least three out of four items. Commuting to work was self-reported by the categories car/motorbike (referred to here as motorized transport), public transport, biking, walking and not applicable. The categories biking and walking were later combined (referred to here as active transport), and participants answering "not applicable" were excluded from the analysis.

2.3.10 Other

Data on sex, age and location of residence were available from the population registry of Norway. Intentions to improve diet and increase PA were assessed by self-report in the NHSS study (Appendix III) (29).

2.4 Statistical analyses

The statistical procedures are described in the various papers. Briefly, the descriptive data are presented as the mean and SD or numbers and proportion (%). Student's t-test for independent groups and chi-square tests for proportions were employed to identify differences between age groups (Paper I), sex (Paper I, III and IV) and geographical area (Paper I and IV). Pearson's correlation coefficient (r) was used to investigate the relationship between PA and CRF (Paper I).

To investigate trends over time in Sogn & Fjordane (Paper II), we used two-level linear (continuous data) and logistic (categorical data) mixed model regression analyses with random intercepts for municipalities (n=26), and with time (actual year) as the fixed variable. Due to the substantial differences in the sample size and participation rate between different cohorts, a trend analysis was performed from 1975-1999, and the developments from 1999-2010 were described by comparing the levels of risk factors. To compare the trends in Sogn & Fjordane with those in the rest of Norway, we applied a two-level mixed model regression analyses including random intercepts for the counties (n=19) (because a municipality variable was unavailable in the rest of Norway) and fixed effects for group (Sogn & Fjordane vs. the rest of Norway), time and the interaction group*time. The results are reported as changes (continuous variables) and odds ratios (OR, categorical variables) with 95% CI and observed significance levels.

Bland-Altman plots (153) and ICC were used to investigate the agreement between measured and self-reported weight and height in Kan1S&Fj and to investigate the agreement between the two automatic blood pressure instruments (Dinamap and Omron) and the two blood pressure instruments used in Kan1 and Kan1S&Fj (Omron and Big Ben) (Paper II). Due to minor differences between crude BMI and BMI adjusted for measurement method and for smoking, crude BMI results are presented. The blood pressure data were corrected for the blood pressure measurement instrument, using the Omron data as the reference.

Multiple linear regression analyses (full model) were used to analyze the association between objectively measured MVPA (Paper III and IV), sedentary time (Paper III) and overall PA (Paper IV) (all dependent variables) and a set of characteristics, including the following: sex; baseline BMI, perceived health, musculoskeletal pain and stiffness; psychological complaints; intention to improve diet or increase PA; smoking; self-reported PA levels; changes in BMI, perceived health, smoking and education levels (Paper III); size of home municipality; community perception score; perceived walkability score; and commuting (Paper IV) (all independent variables). Results were presented as regression coefficients (β), p-values and 95% CIs. In Paper IV, analyses of covariance were used to test the interaction of location of residence*tertiles of potential correlates in relation to PA levels (dependent variable), adjusted for the potential confounders mentioned above (Figure 8). For the categorical independent variables, the interaction variable location of residence*potential correlates was used.

Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS), versions 17.0 (SPSS, Inc., Chicago, IL, USA) (Paper I) and 20.0 (IBM Corporation, Somers, NY, USA) (Paper III and IV) and STATA version 12 (StataCorp, College Station, TX, USA) (Paper II). The significance level was set to $p \leq 0.05$.

3. Results

The following section summarizes the main findings of Paper I-IV. For details, the reader is referred to the original papers (included at the end of the thesis).

3.1 Paper I

Sample characteristics. The final sample in Kan1S&Fj (2008-2010) included 314 40-42-year-olds (61% participation rate) and 308 53-55-year-olds (62% participation rate) in phase one, and 107 40-42-year-olds (56% of the invited) and 111 53-55-year-olds (62% of the invited) in phase two. In total, 43% of the participants had high school as their highest completed education. Among 40-42-year-olds, women had significant longer education compared to men (p<0.001).

Levels of objectively measured PA and CVD risk factors. Table 1 shows objectively measured PA levels by age group, stratified by sex. In the 40-42-year-old group, a significant difference between men and women was observed for MPA; women spent 6.0 min/day (95% CI: -11.7 to -0.3) less time in MPA compared to men. In the 53-55-year-old-group, women were sedentary for 36.0 min/day (95% CI: –55.2 to –16.8) less than men. Women spent 26.4 min/day (95% CI: 7.7 to 45.2) more time in LPA compared to men. In addition, a significant difference was observed between the age groups in VPA. The 40-42-year-old-group spent 2.7 min/day (95% CI: 1.6 to 3.9) more participating in VPA compared to the 53-55-year-old-group (p<0.001).

Table 1. *Levels of objectively measured physical activity by age and sex, mean (SD).*

	40-42-year-olds (n=300)			53-55-year-olds (n=298)		
	Men	**Women**	**p for sex**	**Men**	**Women**	**p for sex**
Overall PA (cpm)	424.0 (161.3)	402.9 (142.4)	0.229	382.7 (144.3)	402.9 (143.9)	0.230
SED (min/day)	516.5 (86.7)	513.0 (74.0)	0.700	546.2 (85.2)	510.2 (81.8)	<0.001
LPA (min/day)	340.9 (77.5)	336.4 (75.2)	0.610	311.4 (80.1)	337.8 (82.3)	0.006
MPA (min/day)	41.2 (27.3)	35.2 (21.0)	0.039	38.9 (22.7)	41.5 (24.4)	0.362
VPA (min/day)	4.6 (8.2)	5.4 (9.5)	0.404	2.7 (5.7)	2.1 (4.3)	0.265
MVPA (min/day)	45.8 (30.0)	40.7 (25.1)	0.119	41.7 (25.0)	43.5 (25.9)	0.534

PA, physical activity; SED, sedentary time; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity; cpm, counts per minute.

According to the previous PA guidelines (-2013), 30% of the population in Sogn & Fjordane met the guidelines (Paper I). Supplementary analyses showed that a significantly higher proportion of the 40- and 50-year-olds in Sogn & Fjordane met the current guidelines for PA (2014-) (72) compared to the same age group in the rest of Norway (44% vs. 29%, p<0.001). In Sogn & Fjordane, significantly more women compared to men met the guidelines for the two age groups combined (49.6% vs. 37.0%, p=0.002). Within the age groups, a significantly higher proportion was observed for women in the 53-55-year-old-group (52.9% vs. 46.6%, p=0.012), but not in the 40-42-year-old-group (Figure 5). No significant difference was observed between the two age groups for men and women combined. For CRF, men had significantly higher CRF compared to women in both age groups (p<0.001), whereas the 40-42-year-old-group had significantly higher CRF compared to the 53-55-year-old-group (p<0.001) (see Figure 3, Paper I for details).

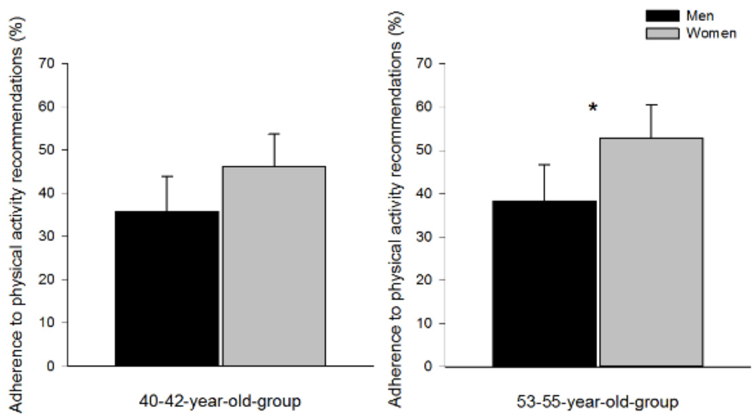

Figure 5. *Adherence to the current physical activity guidelines by age group and sex in Sogn & Fjordane. For 40-42-year-olds n=298, for 53-55-years-olds n=298 * p=0.012.*

Levels of other CVD risk factors are presented in Table 2 by age groups, stratified by sex. In the 40-42-year-olds, 32% and 14.8% of women and 47.2% and 13.0% of men were overweight (BMI 25.0-29.9) and obese (BMI ≥30.0), respectively. In the 53-55-year-olds, 35.0% and 8.0% of women and 50.4% and 13.6% of men, were overweight and obese, respectively.

Table 2. *Levels of other cardiovascular disease risk factors by age and sex, mean (SD).*

	40-42-year-olds (n=99-294)				53-55-year-olds (n=105-294)			
	Men	**Women**	**All**	**p for sex**	**Men**	**Women**	**All**	**p for sex**
BMI (kg/m^2)	26.4 (3.6)	24.9 (4.3)	25.5 (4.1)	0.002	26.8 (3.8)	24.9 (3.6)	25.7 (3.8)	<0.001
WC (cm)	92.2 (12.5)	82.9 (12.0)	86.7 (13.0)	<0.001	94.5 (10.5)	83.5 (10.5)	87.5 (11.7)	<0.001
SBP (mmHg)	135.7 (11.6)	124.7 (11.6)	129.2 (12.8)	<0.001	140.0 (13.9)	135.9 (15.6)	137.4 (15.0)	0.179
DBP (mmHg)	80.8 (9.2)	76.7 (9.4)	78.3 (9.5)	0.029	84.5 (8.7)	82.0 (9.0)	82.9 (9.0)	0.151
TC (mmol/L)	5.45 (0.98)	5.17 (0.90)	5.29 (0.94)	0.142	5.68 (0.99)	5.91 (0.93)	5.83 (0.95)	0.224
HDL-c (mmol/L)	1.42 (0.38)	1.70 (0.43)	1.58 (0.43)	0.001	1.33 (0.38)	1.82 (0.52)	1.64 (0.53)	<0.001
TG (mmol/L)	1.67 (1.01)	1.01 (0.50)	1.28 (0.82)	<0.001	1.99 (1.46)	1.27 (0.57)	1.53 (1.04)	0.006
LDL-c (mmol/L)	3.29 (0.74)	3.01 (0.84)	3.12 (0.81)	0.090	3.58 (0.87)	3.52 (0.83)	3.54 (0.84)	0.729
Smokes, n (%)	23 (17.8)	29 (16.4)	52 (17.0)	0.737	23 (17.6)	33 (19.2)	56 (18.5)	0.443

BMI, body mass index; WC, waist circumferences; SBP, systolic blood pressure; DBP, diastolic blood pressure; TC, total cholesterol; HDL-c, high density lipoprotein; TG, triglyceride; LDL-c, low density lipoprotein.

Significant differences were observed between the two age groups, showing that the 40-42-year-old-group had 8.2 mmHg (95% CI: –11.9 to –4.5) lower SBP values, 4.6 mmHg (95% CI: –7.0 to –2.1) lower DBP values, 0.55 mmol/L (95% CI: –0.80 to –0.29) lower TC and 0.41 mmol/L (95% CI: –0.64 to –0.19) lower LDL-c values compared to the 53-55-year-old-group (p<0.001 for all).

3.2 Paper II

Sample characteristics. The study sample from the NHSS study, the Kan1 study and the Kan1S&Fj study comprises 40-42-year-olds in Sogn & Fjordane (n=21,372) and in the rest of Norway (n=354,310) from 1975-2010.

Trends in self-reported physical activity and CVD risk factors. In total, self-reported LTPA has been relatively stable over 35 years. For sedentary behavior, no significant trend was observed between 1975-1999 for men and women combined (Table 3). However, split by sex, a significant trend toward a decrease in sedentary behavior was observed for women (OR 0.992, 95% CI: 0.985 to 0.999), whereas an increasing trend was found for men (OR 1.012, 95% CI: 1.004 to 1.020). For both sexes, a decrease was observed from 1999-2010 (Figure 6a). A significant increasing trend was observed in LPA (for women only) and VPA (for both sexes) from 1975-1999 (Table 3). From 1999-2010, there was a decrease in LPA and a further increase in VPA (Figure 6b). A significant decreasing trend in MPA was observed for both sexes from 1975-1999 (Table 3); however, there was a trend toward an increase in MPA from 1999-2010 (Figure 6b).

Table 3. *Trend in self-reported leisure time physical activity in Sogn & Fjordane from 1975-1999, n=21,039.*

	Change (OR)	95% CI	p-value
Sedentary behavior	1.002	(0.997, 1.007)	0.481
LPA	1.007	(1.003, 1.011)	<0.001
MPA	0.985	(0.981, 0.990)	<0.001
VPA	1.037	(1.021, 1.054)	<0.001

CI, confidence interval; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity. All data are yearly average ORs.

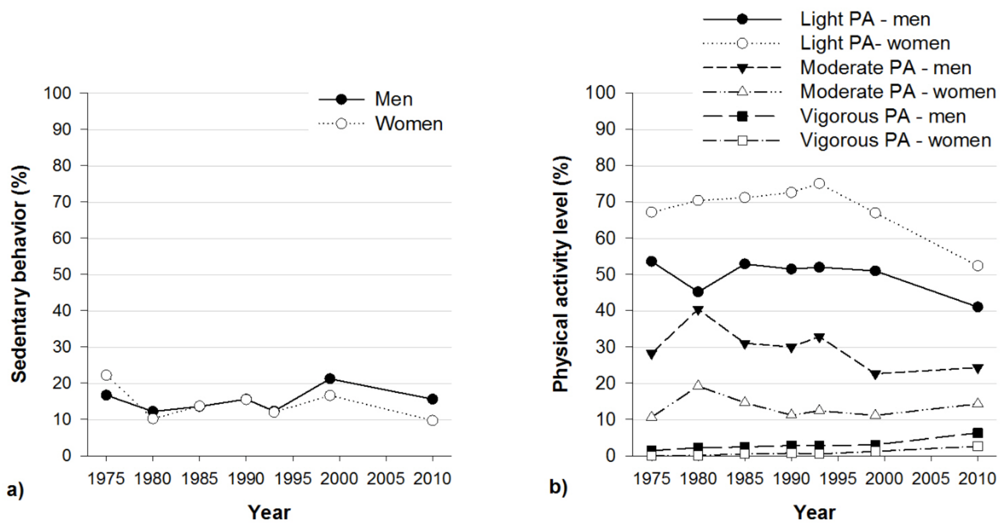

Figure 6. *Trends in self-reported leisure time physical activity in Sogn & Fjordane 1975-2010, stratified by sex, proportion (%), n=21,372.*

A significant decreasing trend in smoking was observed among men from 1975-1999, whereas a significant increasing trend was observed among women (Figure 7a). Thereafter, there was a decrease in smoking for both sexes. Body mass index (Figure 7b) increased between 1975-1999 for both sexes, but the trend leveled off thereafter. Over the past 35 years, BMI has increased by 1.8 kg/m^2 for men and 0.7 kg/m^2 for women. With regard to SBP and DBP, a significant decreasing trend was observed for both sexes from 1975-1999 (Figure 7c). From 1999-2010, an increase was observed for both sexes. Significant decreasing trends in TC and HDL-c were observed for both men and women between 1975 and 1999 (Figure 7d). From 1999-2010, an additional decrease in TC was observed, whereas an increase in HDL-c was observed for both sexes. A significant increasing trend in TG was observed between 1975 and 1999, but TG decreased for both sexes after 1999.

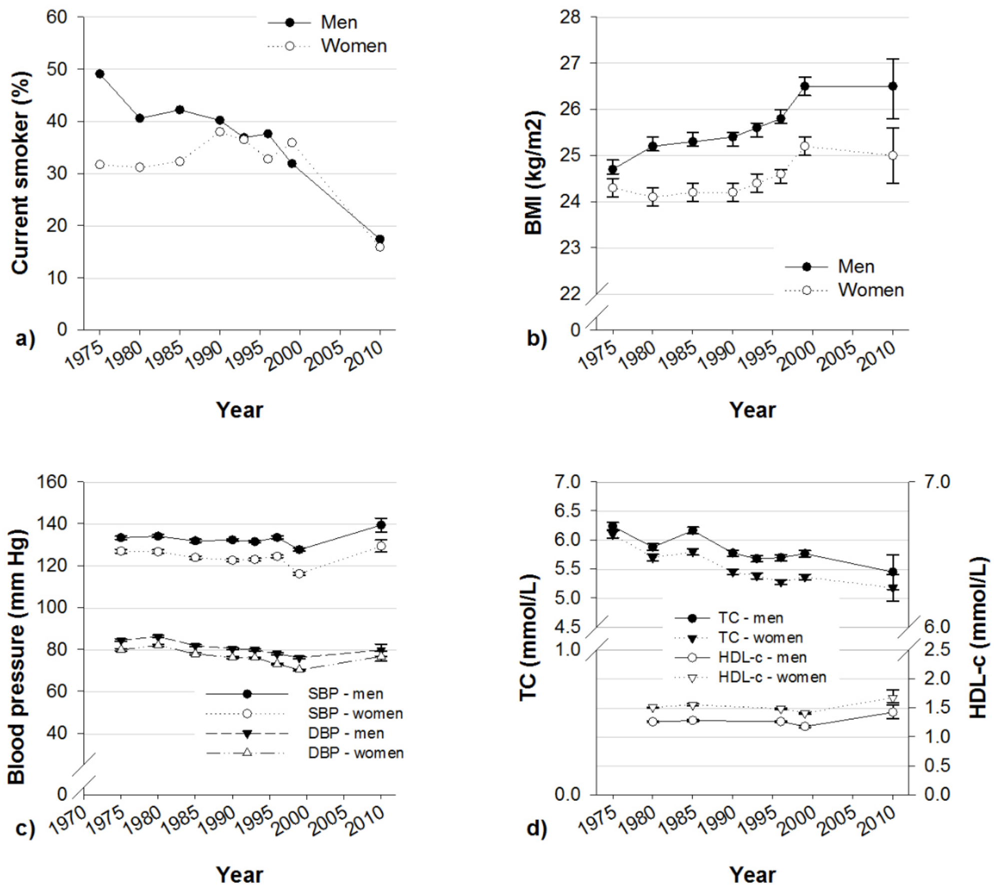

Figure 7. *Trends in other risk factors in Sogn & Fjordane 1975-2010, stratified by sex, proportion (%) or mean (95% CI). Body mass index; BMI, systolic blood pressure; SBP, diastolic blood pressure; DBP, total cholesterol; TC and high density lipoprotein; HDL-c, n=21,372.*

Compared with the rest of Norway, Sogn & Fjordane showed trends toward improvements in TG (difference in trend -0.003 mmol/L, 95% CI: -0.002 to -0.004, p<0.001), HDL-c (difference in trend 0.001 mmol/L, 95% CI: 0.002 to 0.000, p=0.045) and BMI (difference in trend -0.04 kg/m^2, 95% CI: -0.03 to -0.04, p<0.001) but less beneficial trends for SBP (difference in trend

0.06 mmHg, 95% CI: 0.09 to 0.04, $p<0.001$) and DBP (difference in trend 0.04 mmHg, 95% CI: 0.06 to 0.02, $p<0.001$). No difference in trends was found for self-reported LTPA between Sogn & Fjordane and the rest of Norway.

3.3 Paper III

Sample characteristics at baseline. The study sample from the NHSS study and the Kan1S&Fj study consists of participants with valid data at both baseline (in 1996) and follow-up (in 2009), which in total yielded 240 eligible participants (52% of the original sample; 44% men). At baseline, mean BMI was 26.3 (3.5) kg/m^2 for men and 24.3 (3.7) kg/m^2 for women. In total, 89% of the participants reported their health to be good or very good. Twenty percent of the participants were smokers. In total, the majority (63%) reported their highest completed educational level to be in the two lowest groups (i.e., high-school or less). Approximately 46% reported a moderate to vigorous activity level at baseline. Men reported significantly higher levels of PA than women ($p=0.006$).

Demographical, biological, psychological and behavioral correlates of objectively measured physical activity. Self-reported PA at baseline and improved perceived health from baseline to follow-up were positively associated with objectively measured MVPA at follow-up in a graded manner ($p\leq0.046$) (Table 4). Each unit of difference in BMI at baseline and each unit of increase in BMI from baseline to follow-up were negatively associated with MVPA at follow-up ($p\leq0.034$). The correlates included in the model explained 15.7% of the variance in MVPA.

Table 4. *Long-term associations of objectively measured moderate-to-vigorous physical activity (MVPA) (min/day), n=240.*

	MVPA (min/day)		
	β	**p-value**	**95% CI**
BMI (kg/m²)	-1.00	0.034	(-1.91, -0.08)
Self-reported PA	8.796	<0.001	(4.07, 13.51)
Δ BMI	-1.94	0.014	(-3.47, -0.40)
Δ Perceived health	6.09	0.046	(0.12, 12.06)

β, regression coefficient; CI, confidence interval; BMI, body mass index; PA, physical activity; Δ, change from 1996 to 2009.

Sex was associated with objectively measured sedentary time at follow-up as women spent less time being sedentary than men (β -28.76, 95% CI: -52.77 to -4.75, p=0.019). Educational level at baseline was positively associated with sedentary time at follow-up in a graded manner (β 27.29, 95% CI: 17.58 to 37.00, p<0.001), whereas improved perceived health from baseline to follow-up was negatively and graded associated with sedentary time at follow-up (β -27.18, 95% CI: -47.90 to -6.46 p=0.010). The correlates included in the model explained 12.9% of the variance in sedentary time (See Table 3, Paper III for details).

3.4 Paper IV

Sample characteristics. The study sample from the Kan1 and Kan1S&Fj study in 2008-2009 included 972 adults (40% participation rate) (n=590 from Sogn & Fjordane and n=382 from the rest of Norway). The average age was 46.9 (6.5) years and 43.8% of participants were men. The majority of the participants were employed (96% in Sogn & Fjordane and 95% in the rest of Norway). Approximately 80% of the participants in both areas reported their health to be good. In Sogn & Fjordane and the rest of Norway, 52.7% and 48.3% were overweight or obese, respectively, whereas 17.2% and 19.5% were smokers. Significant differences between Sogn & Fjordane and the rest of Norway were observed for time spent in objectively measured MVPA (p<0.001), education level (p=0.012), size of home municipality (p<0.001), community perception score (p<0.001) and type of commuting to work (p<0.001). Compared to the rest of Norway, the population in Sogn & Fjordane were significantly more physically active (43.1 (26.6) min/day vs. 34.4 (23.0) min/day of MVPA), were less educated (50.2% vs. 41.3% having high school education or lower as their highest education), lived in less populated municipalities (99.3% vs. 14.6% living in municipals with 10.000 inhabitants or less), reported lower community perception scores (3.1 vs. 3.4), were more likely to commute to work by active transport (21% vs. 15%), and less likely to commute by public transport (1.6% vs. 7.3%). Significant differences between the sexes were observed within Sogn & Fjordane, where women had significantly higher education levels ($p=0.015$) with lower perceived walkability scores ($p=0.007$) compared with men.

Built environment correlates of objectively measured physical activity. Sex-specific associations were found for community perception score ($p<0.001$ for both outcomes) and perceived walkability score ($p=0.038$ for MVPA). Living in Sogn & Fjordane, community perception score (for men only), perceived walkability score (for women only) and using active transport for commuting were associated with objectively measured MVPA (all $p\leq0.004$) (Table 5). Adjusted for socio-demographic and health-related factors, the built environment correlates included in the model accounted for 15.7% of the variance in the time spent in MVPA. Adding self-efficacy to the model did not change the associations noticeably (data not shown).

Table 5. *Built environment correlates of objectively measured objectively measured moderate-to-vigorous physical activity (MVPA) (min/day), n=886.*

	MVPA (min/day)		
	B	**p-value**	**95% CI**
S&Fj vs. rest of Norway	8.86	0.004	(2.79, 14.93)
Community perception	-2.20	0.098	(-4.80, 0.40)
Men	-8.71	<0.001	(-12.57, -4.85)
Women	1.92	0.223	(-1.24, 5.07)
Perceived walkability	4.90	<0.001	(2.52, 7.27)
Men	2.42	0.154	(-0.913, 5.75)
Women	7.00	<0.001	(3.91, 10.09)
Commuting			
Motorized transport	Ref		
Public transport	5.57	0.240	(-3.73, 14.87)
Active transport	7.61	0.001	(3.15, 12.07)

All associations are adjusted for sex, BMI, education level, smoking, perceived health and mean daily wear time.
β, regression coefficient; CI, confidence interval; BMI, body mass index.

Geographical area-specific associations were found for community perception scores ($p=0.045$) and use of public transport for commuting ($p=0.027$). Community perception score was associated with objectively measured MVPA in the rest of Norway (β -4.07, 95% CI: -7.24 to -0.90, $p=0.012$ for MVPA), but not in Sogn & Fjordane. The use of public transport for commuting was associated with MVPA in Sogn & Fjordane (β 12.16, 95% CI: 1.20 to 23.12, p=0.03 compared to motorized transportation), but not in the rest of Norway. A visual inspection of the associations between objectively measured MVPA and the correlates for Sogn & Fjordane and the rest of Norway is provided in Figure 8a-c. The figures indicate that the participants in Sogn & Fjordane reporting the lowest third of the community perception score had substantially higher MVPA compared to those reporting higher community perception scores and compared to the rest of Norway (Figure 8a). Although the use of active transport was associated with higher MVPA compared to the use of motorized transport for commuting for both locations of residence (Figure 8c), public transport was associated with the highest MVPA level in the rest of Norway, whereas the opposite pattern was observed in Sogn & Fjordane. For perceived walkability score (Figure 8b), the same pattern was observed for both locations of residence (i.e., MVPA increased with higher scores). However, the level of MVPA was higher in Sogn & Fjordane compared with the rest of Norway. The same patterns as for MVPA were observed for overall PA (data not shown).

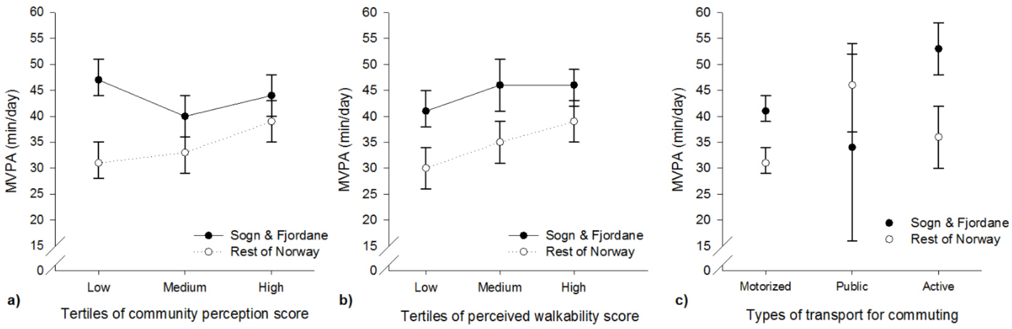

Figure 8. *Association between objectively measured moderate-to-vigorous physical activity (MVPA) (min/day) and a) community perception score, b) perceived walkability score and c) types of transport for commuting, by location of residence, n=728-903. All associations are adjusted for sex, BMI, education level, smoking, perceived health and mean daily wear time.*

4. Discussion

This thesis presents data from the first epidemiological investigation of objectively measured PA and its correlates in adults in Sogn & Fjordane. In addition, we present trend data on self-reported PA and CVD risk factors over 35 years. The differences in life expectancy and CVD mortality between Sogn & Fjordane and the rest of Norway are now less pronounced (30, 39). However, this study indicates that the population in Sogn & Fjordane has maintained its beneficial position with respect to PA levels and several CVD risk factors, and that PA levels are associated with correlates such as PA earlier in life, BMI, perceived health and built environment. The following general discussion will primarily focus on the main results and the strengths and limitations of the data.

4.1 Trends and levels in physical activity and cardiovascular disease risk factors – Paper I-II

4.1.1 Physical activity

Overall, the self-reported LTPA level in Sogn & Fjordane has been relatively stable over the 35-year study period. Positive trends were observed in terms of sedentary behavior (for women), LPA and VPA; however, commitment to MPA decreased, and among men sedentary behavior increased (Paper II). Today, even though levels of objectively measured PA are low, the population in Sogn & Fjordane seems to be more physically active compared with the rest of Norway (27, 159), other European populations (110, 135) and the USA (136) (Paper I). Still, given the low levels of PA and the health benefits of sufficient PA, there is great potential to increase PA levels (22, 74).

Trend data on PA following different cohorts of different ages are scarce (19). The observed trend in self-reported LTPA may indicate a shift from recreational walking toward specific training activities. The increasing trend in sedentary behavior for men and the overall decreasing trend in MPA in Sogn & Fjordane might also signal a transition toward less physically demanding work (90) in addition to increasing use of motorized transportation. Our study partly corroborates previous observations by Anderssen et al. (16), who also found a downward trend for sedentary behavior (for women) and MPA (for men), as well as an upward trend for sedentary behavior (for men) and VPA in Norway from 1972-2002. In Finland, Borodulin et al. (80) found an increasing trend in self-reported LTPA during the same period. Both these studies used the same PA questionnaire as in our study. For decades, lower levels of sedentary behavior and time and higher levels of PA have been observed in the population in Sogn & Fjordane compared with the rest of Norway (29, 55, 89). We observed no differences in trend between the areas. This indicates that Sogn & Fjordane has maintained its beneficial position with respect to PA, despite the changes in activity pattern that most likely have occurred through a reduction in occupational and daily life PA and an increase in specific training activities. Our results suggest that similar changes have occurred in the rest of Norway.

We found no sex differences in objectively measured overall PA level. This is in line with national data (27), but differs from the National Health and Nutrition Examination Survey (NHANES) in the USA and the ABC study in Sweden, which found that men were more physically active than women (135, 136). However, we did observe sex differences in time spent in different intensities of PA, indicating that, in the 40-42-year-old-group, men spent more time in MPA than women, and that in the 53-55-year-old group, men spent more time sedentary and less time in LPA than women. These results are in agreement with observations from the rest of Norway (27) and partly in line with the results of the NHANES and ABC studies (111). In contrast to national data (27), we also noted age differences, with more time spent in VPA among 40-42-year-olds compared to 53-55-year-olds. This may be explained by the inclusion of a large sample with a narrow age range in Kan1S&Fj, whereas a nationwide representative sample with a broader age range was included in Kan1.

With respect to trends in self-reported PA, our observations contribute to the inconsistent results found for LTPA in previous studies (16, 19, 80, 81) and most likely suffer from the same methodological weaknesses as prior self-reported measurements (25). The objective measures of PA confirm previous self-reported observations of healthy levels of PA among individuals living in this specific area (29, 55, 89). However, adherence to the PA guidelines in the present study is in strong contrast to other Norwegian studies which used self-reported PA and found higher adherence to the PA guidelines (ranging from 50% to 70%) (85, 91, 92, 139). Although comparisons with international populations may be hampered by the differences in cut-off ranges for age groups and slightly different methods of data reduction among the studies (111), the introduction of objective measurements of PA has provided an important contribution to epidemiologic data on PA. Objectively measured PA provides more precise information (137) and enables analysis adjusted to the PA guidelines. Together with the national Kan1 study (27), our studies facilitate the gathering of trend data and longitudinal data, based on objective measures, both nationally and regionally. In addition, when implementing effective strategies to increase daily PA levels, objective data may help to more precisely identify targeted groups. Furthermore, objective PA measures provide more precise data for evaluating such strategies.

4.1.2 Overweight and obesity

The steady increase in BMI for men and the slightly U-shaped trend for women confirm the BMI trends identified in other national studies (16, 29, 62, 98), as well as by some international studies (93, 94, 99-101). Attempts to explain the substantial increase in overweight and obesity have focused on increases and changes in diet and decreases in PA, among other factors (97). A substantial acceleration in the BMI increase was observed in the beginning of the 1990s for both sexes and may be associated with the accelerating digital revolution that occurred at about the same time. Anderssen et al. (16) found that the increase in BMI was significantly larger in sedentary individuals compared with those who were more physically active. The development is most likely due to a changing environment that promotes calorie intake and counteracts energy expenditure (16). The decrease in smoking prevalence could also partly explain the BMI increase. In a similar but smaller population-based sample from the NHSS study, Kvaavik et al. (120) found that current smokers had the lowest BMI and that former smokers had the highest BMI. This association has been confirmed by other researchers (160). Recent studies have indicated a possible halt in the obesity epidemic (63, 65). Our study indicates that BMI values have plateaued during the last decade. Midthjell et al. (63) did not find a plateau in either BMI or WC in another Norwegian population, but they did observe a plateau in the proportion of the population that was overweight. Based on our data we cannot conclude whether this plateau is a result of changes in PA, diet or other factors. The observed plateau may also be an artifact of the measure applied (63) or a result of lower participation rate in the most recent cohort where the leanest may have been recruited.

The BMI trends in Sogn & Fjordane were less unhealthy compared with the national data; today, BMI is still marginally lower in Sogn & Fjordane compared to national (27) and other regional data from the HUNT and Tromsø study (63, 161, 162). The same was observed for WC where men and women in Sogn & Fjordane had 2.9 cm and 6.8 cm smaller WC respectively compared to the same age-group in the HUNT population (63). However, recent data on BMI gathered in military recruits suggest a higher BMI and a greater BMI increase among young men in Sogn &

Fjordane compared to other regions of Norway (53). This could indicate a future shift in the population of Sogn & Fjordane, and emphasizes the importance of preventing overweight and obesity in young men. However, it is important to note that BMI is not a direct measurement of body fatness and does not distinguish between fat and muscle mass. Rather, BMI is a surrogate for adiposity and a useful measure to explore trends in population-based studies (163).

4.1.3 Smoking

The observed decrease in smoking confirms previous studies nationally (14, 16, 98) and internationally (15); the pattern in Sogn & Fjordane over the last 35 years is similar to observations in the rest of Norway. We found no significant difference in smoking between Sogn & Fjordane and the rest of Norway in 2010. Compared to the present national proportion of smokers (104), the smoking rate in Sogn & Fjordane from 2010 is slightly higher. However, we cannot rule out the possibility that a further decrease in smoking has also occurred in Sogn & Fjordane. The decrease in smoking rates is most likely an example of the results of dedicated public health work with a focus on public health education campaigns and politics during the last decades (14, 15). In addition to an educational approach that emphasized information and moral appeals, structural initiatives have been implemented. Examples of such initiatives are regulation of smoking through legislation, pricing and placing cigarettes in hard-to-find locations in stores.

4.1.4 Blood pressure

The decreasing trend found in SBP and DBP in both Sogn & Fjordane and the rest of Norway is supported by national (86, 98) and international (106) studies. The less healthy trend in blood pressure in Sogn & Fjordane compared with the rest of Norway might be the result of a delayed development in an already healthy population. In Norway, the substantial decrease in blood pressure in the late 1990s has previously been mentioned as a possible methodological artifact, at least in part (155). The decrease has occurred despite the increase observed in BMI and is opposite to the significant positive association found between blood pressure and BMI in previous studies (164). The use of antihypertensive medications has increased from 2004-2010 (165), but in 2010 there was no difference between Sogn & Fjordane and the rest of the country (data not shown). No data prior to 2004 exist, but statistics based on wholesalers indicate a substantial increase in the use of antihypertensive medications from 1980-2003, both in Sogn & Fjordane and throughout Norway (Sakshaug, S, Norwegian Institute of Public Health, personal e-mail communication). However, the proportion of people who use antihypertensive medications indicates that these individuals may have contributed only marginally to the population values (98, 107). Today, except for SBP in 53-55-year olds, mean blood pressure levels were within the limits of normal blood pressure (10). Considering the fact that hypertension is ranked as the leading risk factor for death globally (6), maintenance of sufficiently low blood pressure is essential to maintain good public health. Therefore, future studies to detect whether the observed increase from 1999-2010 is real or an artifact are necessary.

4.1.5 Lipids

The decreasing trend observed in TC is consistent with national (86, 98) and international observations (109). No significant differences in trend were found between Sogn & Fjordane and the rest of Norway. However, with regard to HDL-c, the trend in Sogn & Fjordane was slightly better, which may be explained by the higher levels of PA, as physically active individuals typically have higher HDL-c levels than their less active counterparts (166). This is supported by the observed increases in HDL-c and in LTPA from 1999-2010. Today, the TC level in Sogn & Fjordane is similar to the HUNT population for men, but lower for women, whereas the HDL-c level is higher for both men and women in Sogn & Fjordane compared to the HUNT population (167). Based on the inverse association observed between BMI and HDL-c (168), the contradictory observations regarding HDL-c levels may be explained by the higher BMI in the HUNT population compared to the rest of Norway.

4.2 Why are some people more active than others? Paper III-IV

The reasons underlying why some people are physically active while others remain inactive are multifactorial, complex and not yet fully understood (112, 114). Hence, a better understanding of factors associated with PA level is important in order to develop and improve public health interventions (112, 114). We have tried to provide additional knowledge in this field by studying behavioral, health-related and demographic correlates of objectively measured PA in a longitudinal observational study (Paper III), as well as built environmental correlates in a cross-sectional study (Paper IV).

4.2.1 Behavior and health factors

Physical activity levels appear to remain stable within a group over time, as determined by what is typically referred to as tracking (112, 115-117, 169). Compared to cross-sectional designs that have no time dimension and cannot determine causality, prospective data are believed to give more valid and less biased results. The tracking correlation tends in general to be greater over shorter rather than longer periods (169). In a prospective study using objectively measured PA, Hamer et al. (115) found that PA in middle age partly tracked into older age. Based on self-reported PA data, Kirjonen et al. (119) suggested that "lack of interest in participating in PA" in early adulthood was associated with lower levels of PA later in life. Although most studies report low to moderate tracking of PA (117, 119, 170), indicating that many other factors influence PA (169), the importance of establishing health-enhancing behaviors such as PA early in life has been emphasized (169). Based on self-reported PA, Telama et al. (169) observed that the probability of being active in adulthood was higher if PA lasted for several years in youth. Our findings corroborate and partly extend these previous studies, suggesting that previously self-reported PA is associated with later levels of objectively measured PA. These results emphasize the importance of encouraging people to take up and maintain a sufficient level of PA at a young age. Being continuously physically active may lead to motivation and motor skills that increase the probability of remaining active (169). However, it is problematic to infer causality from prospective studies that measure exposures and outcomes with different degrees of measurement error (171). Furthermore, the differences in assessment and categorization of PA between studies are considerable and hamper comparisons between studies.

We also observed that both lower baseline BMI and less increase in BMI were associated with higher objectively measured PA later in life, consistent with some (112, 115, 116, 171) but not all (119) previous observations. However, the association between BMI and PA is most likely bi-directorial, because habitual PA throughout life is associated with less weight gain (127). This is supported by the logic of the energy balance equation (97). However, most studies have used self-reported PA assessment methods to examine the prospective association between PA and obesity outcomes (171).

Although health status has appeared to be an important factor for PA in previous studies (115, 118, 119), we did not observe any association between perceived health at baseline and objectively measured PA later in life. This may be explained by differences in age between the study populations and different measures of PA and perceived health (115, 118, 119). Nevertheless, we observed that improved perceived health from baseline to follow-up was associated with increased PA levels. Thus, present perceived health seems more important for PA than perceived health in the past.

4.2.2 Demographics

Although educational level has been found to be positively associated with PA (112, 115, 116), the association has not been consistent in prospective studies (118), corroborating our observations. Contrary to others (115, 119), we found a positive association between level of education and time spent sedentary. Hamer et al. (115), who also employed an objective measure of sedentary time, found that participants with higher educational levels spent 42 min/day less time sedentary compared to individuals at the lowest educational level. Kirjonen et al. (119) suggested that low education was associated with an increased probability of remaining sedentary. Discrepancies between studies may be explained by differences in study populations, as education may be differently linked with work opportunities and with more or less physically demanding place and type of dwelling. For example, Hamer et al. (115) examined these associations in a fairly homogeneous sample of healthy people who participated in the Whitehall study, whereas our participants lived in rural Norway. Generally, it is likely that individuals with more education tend to have sedentary, desk-based work, which may contribute to their higher overall sedentary time.

Our observation suggesting that men have higher amounts of sedentary time than women are in agreement with previous observations using objective measures of sedentary time (27, 110). In several (27, 116), but not all (110), studies using either self-reported or objectively measured PA levels, it has been observed that men spent more time in MVPA than did women. We did not observe a sex difference in MVPA. The relatively high adherence to the PA guidelines compared to other populations, especially among women, indicating that this population spends a fair amount of time doing specific training activities, may explain the lack of sex differences in MVPA. However, this prospective finding is contrary to our own cross-sectional data showing higher MPA levels among men compared to women, and may be due to the smaller sample size in the prospective study.

4.2.3 Community neighborhood

Although early findings suggest ambiguous associations between perceived environment and PA (122, 172), convincing evidence for a positive relationship between community perceptions and PA levels has been found in more recent European studies (124). This is contrary to our observations, in which a higher community perception score was associated with lower amounts of objectively measured PA for men in the rest of Norway. Hansen et al. (125) found no association between the same community perception measure and PA in a Norwegian population-based sample and argued that the reasonably high mean score was not able to discriminate sufficiently between the groups. Our mean scores are equally high; however, the narrow age range in our sample may explain the divergent results for part of the sample. The majority of our study population was employed, which could have influenced this association. Moreover, cultural aspects may have an impact. Throughout Norway, there is easy access to nature, and recreational areas are close to where people live, which could have encouraged PA. However, perhaps because the competing availability of activities led to sedentary time, a substantial proportion of the population did not appear to use these facilities. The substantially higher MVPA observed in those reporting the lowest community perception score in Sogn & Fjordane compared with those reporting higher scores and compared with the rest of Norway suggest that correlates other than perceptions of community may influence PA. One hypothesis is that self-efficacy could partly explain the somewhat unexpected association between community perception and MVPA (112). However, including self-efficacy in the model did not change the associations noticeably. The population in Sogn & Fjordane may choose to be active, or need to be active (for transportation), despite their neighborhood surroundings.

4.2.4 Walkability and commuting

Walkability has been suggested to be positively related to overall PA, transportation walking and transportation biking (124). A Swedish study (173) found that individuals living in highly walkable neighborhoods walked 50 minutes more for active transportation/week and had 3 minutes more time of MVPA/day compared to those living in less walkable neighborhoods. Our findings extend this work, as people reporting higher perceived walkability had higher levels of objectively measured PA in both Sogn & Fjordane and the rest of Norway.

As expected, we found a positive association between active transport for commuting and PA. This emphasizes the importance of encouraging active transport within communities. The higher proportion of those using active transport in Sogn & Fjordane compared with the rest of Norway is contrary to previous studies that showed a positive relationship between degree of urbanization and biking for transportation (124). However, although the population density is low and many people in Sogn & Fjordane live scattered over a wide area, many people live in small urban areas, enabling active transport. The association observed between public transport for commuting and MVPA in Sogn & Fjordane but not in the rest of Norway could possibly be explained by the public transport pattern and availability. Compared to more urban areas, the public transport system in Sogn & Fjordane is poorly developed, which may explain why only 1.6% of the population used public transport for commuting. Furthermore, people using public transport in Sogn & Fjordane are less physically active compared to those using motorized transportation, whereas the opposite was observed in the rest of Norway. In Sogn & Fjordane, highly educated people may have to commute to another municipality for work. Most likely due to the poorly developed public transport system, these people use motorized transport. Considering the well-established association between education level and LTPA (112, 115, 116), this may explain the difference in associations between public transport and MVPA in Sogn & Fjordane and the rest of Norway. However, when interpreting these results, the small proportion of participants reporting the use of public transport should be considered.

4.2.5 Location of residence

Even though most of the sample in Sogn & Fjordane lived in municipalities with fewer than 10,000 inhabitants, and the majority of the sample from the rest of Norway lived in municipalities with more than 10,000 inhabitants, we cannot categorize Sogn & Fjordane as rural and the rest of Norway as urban. However, the location of residence as a correlate for objectively measured PA may be supported by studies suggesting that people living in less urbanized areas tend to be more physically active (124). In addition, the presence of hills in the neighborhood and enjoyable scenery have been found to be associated with more activity (174); although, a possible negative relationship has been suggested between biking for transport and hilliness (124). Community environment, walkability and degree of urbanization have all been suggested to be associated with PA; however, all these factors have been shown to be unrelated to recreational PA (124). The county of Sogn & Fjordane has a higher level of PA but lower environmental scores compared with the rest of Norway. Except for the fact that a larger proportion of the population in Sogn & Fjordane uses active transport for commuting, we do not know if any significant differences are present in the types of PA engaged in by the residents of Sogn & Fjordane. However, there may be other explanations for the significantly higher PA levels in Sogn & Fjordane that we were unable to discover.

4.3 Methodological considerations

Strengths of the present thesis include objective measurements of PA (Paper I, III, IV), which provides more detailed information of levels of PA and is less prone to bias due to misreporting or social desirability compared with self-reported PA (25). Additional strengths include high compliance rates with the protocol and the high response rate from a large (Paper II), nationwide (Paper II and IV), population-based sample with a narrow age range. Moreover, the long time span and consistent measurement and analyses used for most variables (Paper II) are strengths of this study. Finally, the prospective design strengthens our study (Paper III).

However, these findings should be interpreted in light of the following limitations. When investigating associations, we cannot determine any casual relationships based on our data from cross-sectional (Paper IV) and prospective observational (Paper III) designs.

Accelerometry has known limitations (Paper I, III, IV) and does not accurately assess non-ambulatory activity, such as cycling or swimming (137, 175). For people who cycle or do upper-body exercise on a regular basis, PA is underestimated. However, the participants mostly performed ambulatory activities (data not shown), and inclusion of counts that were not registered during cycling accounted for only a 3% difference in the Kan1 study (176). Furthermore, the uniaxial Actigraph used in the present study does not satisfactorily register high-speed activity, such as running over 10 km/h. However, the majority of people do not routinely run at this speed (175). The PA intensity thresholds vary widely between studies (175). This hampers study comparability. To reduce this bias, the present study uses the same cut-off points as were used in the national Kan1 study and the NHANES study (27, 136, 148).

Self-reported exposure variables may be prone to measurement errors that may attenuate the observed associations (177). For example, the association between objectively measured and self-reported PA at follow up was weak (Paper III), although it was in agreement with many previous observations (ϱ=0.27, R^2=0.07) (138, 139, 178). In addition, using self-reported LTPA is a potential source of recall and social desirability bias (25) (Paper II and III). Although the questions were slightly modified to adapt to one's perception of terms, uncertainty related to changes over time in the participants' interpretation of the term LTPA remains to some degree (16, 25) (Paper II). However, currently no data are available from investigations of secular trends in PA using objective measurements in Norwegian adults.

Furthermore, people's perceptions of their environments may be more significantly influenced by their behavior than their actual or objective environments (122, 179). For walkability, an objective Walk Score (180) can be obtained online; however, the scores are not yet supported in Norway (Jacobson, A., Walk Score®, personal e-mail communication). Geographic Information Systems (GIS) providing objective data on build environment are challenging and may provide limitations (181). Self-reported measures of the built environment customized to Norwegian conditions and culture are also scarce. As inter-continental differences in the relationship between physical environment and PA have been identified (124), the use of measures adapted for other countries and continents may bias our data. For example, questions about traffic lights and safety may be irrelevant for parts of the population, whereas more questions about access to mountain and recreational areas may have been appropriate.

Investigating trends over a 35-year span presents measurement challenges (Paper II). Multiple blood pressure devices have been used, but device comparisons have been performed to minimize potential bias and to correct for the instruments used. The use of self-reported weight and height for parts of the population in Kan1 and Kan1S&Fj creates some uncertainty. However, tests of agreement between the self-reported and measured weights and heights from Kan1S&Fj produced satisfactory results, and adjusting for the measurement method yielded results similar to the crude rates. Non-fasting blood samples were taken in Kan1S&Fj, which yields higher values of glucose and triglycerides than if samples were taken in the fasting state. However, this was done to facilitate comparison with the NHSS study, which used non-fasting blood samples (182). A number of correlates and determinants from multiple domains have been suggested to be associated with PA level and sedentary time in adults (112, 114, 116). This study only included a limited number of these correlates and domains (Paper III and IV).

Finally, although the response rates in the most recent wave were high compared to recent similar studies, the response rate was substantially lower compared to the early waves, and we cannot rule out the possibility of selection bias (183). Drop out analysis showed that non-participants at follow-up (Paper III) were more likely to be men ($p=0.036$), smokers ($p<0.001$), have higher BMI ($p=0.012$) and lower PA level ($p=0.003$) at baseline. However, analyses of the non-responders for part of the sample found that the prevalence rates of overweight or obesity and other NCDs were similar to other national estimates (125). Therefore, we believe that the results of this study are generally valid in comparison to similar studies.

4.4 Implications

Despite the significantly higher PA level in Sogn & Fjordane compared with the rest of Norway and the relatively stable trend in PA level over 35 years, the PA level is insufficient from the public health perspective, especially taking into account the convincing evidence of PA’s beneficial effects on health outcomes (20). Regional and national data on PA and its correlates are essential for following health-related developments and to design initiatives that aim to increase PA levels. Due to the methodological weaknesses in self-reported PA measures used in previous surveys, this is the start of systematic monitoring of objectively measured PA levels in adults nationwide. Although some of the changes in level of risk factors seem minor, the changes are large in the population as a whole (184). As a consequence of the regional differences in activity levels, levels of risk factors and the built environment, regional monitoring it is essential to meet the requirement of the Public Health Act (1), which requires each single municipality to provide an overview of their public health challenges. This is essential for creating public health initiatives that are customized to public health challenges in each specific population.

Although there has been an increased public health focus on regular PA in the prevention of NCDs (20-23), PA has not received as much attention as smoking (14-17). Considering the worsening trends in PA compared to smoking during the past decades, it is now time to make PA a major target of public health education campaigns and politics and to create effective interventions that affect major determinants of PA. This study shows that PA earlier in life, BMI, the presence of beneficial health and healthy communities and neighborhoods that promote active living may be key factors that influence daily PA levels. However, we identified several factors that have a modest yet significant association with PA. Therefore, in addition to time series data on objectively measured PA levels, validated subjective and objective measures of the built environment that are adapted to Norwegian conditions are needed in future research. Nevertheless, these changes have the potential to contribute significantly to community participation, as favorable modifications to the community may produce small changes in the behaviors of entire populations. Therefore, identifying environmental factors that can produce positive changes in PA is important.

5. Conclusions

The following conclusions can be drawn on the basis of the results presented in this thesis:

I. Objectively measurements of physical activity show that 44% of the adult population in Sogn & Fjordane meets the current physical activity guidelines. The population is significantly more physically active compared with the rest of Norway (Paper I).

II. Self-reported leisure time physical activity levels have been relatively stable over a 35-year period in Sogn & Fjordane. Significant positive trends were observed in light physical activity and vigorous physical activity, whereas a significant negative trend was observed in moderate physical activity. For sedentary behavior, a significant negative trend was observed in men, whereas a positive trend was observed in women. With respect to smoking, blood pressure and cholesterol, significant decreases were found, whereas increasing trends were observed in body mass index. Compared with the national data, the trends in Sogn & Fjordane were significantly healthier in terms of high-density lipoprotein cholesterol levels and body mass index, but less positive for blood pressure (Paper II).

III. Higher baseline levels of physical activity, lower baseline body mass index, less increase in body mass index and improved perceived health were associated with increased time spent in objectively measured moderate-to-vigorous physical activity 13 years later. However, the correlates included in the present study only explained 16% of the variance in moderate-to-vigorous physical activity, and the results should therefore be interpreted with caution (Paper III).

IV. Objectively measured moderate-to-vigorous physical activity was partly associated with aspects of the built environment such as community perception, perceived walkability and the use of active transport for commuting. Living in Sogn & Fjordane was associated with increased moderate-to-vigorous physical activity compared with the rest of Norway. Geographical differences in the correlates of physical activity were observed for community perception score and the use of public transport for commuting (Paper IV).

6. Recommendations for future research

This thesis presents novel data on objectively measured PA and its correlates, in addition to updated data regarding level and trends in PA and CVD risk factors in Sogn & Fjordane, Norway. The studies have revealed some specific areas in which future research is needed.

To be able to meet the requirements of improving our understanding of developments in health and health habits in Norwegian regions, it is necessary to continue national monitoring programs of objectively measured PA levels and to ensure representative regional data. Inclusion of new participants and obtaining longitudinal data for parts of the population are preferred. In addition, we should strive to accomplish an international consensus on how to process and present accelerometry data. This will facilitate comparisons between studies and populations.

Development of validated subjective measurements regarding the built environment that are adapted to the Norwegian culture and society are essential in order to study culturally determined behaviors. Furthermore, we should strive to develop and validate feasible and objective measures of the built environment, such as walkability.

References

1. Lov om folkehelsearbeid [Public Health Act] (Folkehelseloven). Nr. 29 (2011). Available from: http://lovdata.no/dokument/NL/lov/2011-06-24-29.

2. The Norwegian Directorate of Health. Reduksjon i ikke-smittsomme sykdommer - nasjonal oppfølging av WHOs mål [Reduction in non-communicable diseases - national implementation of WHO's goals]. The Norwegian Directorate of Health. 2013. Available from: http://helsedirektoratet.no/publikasjoner/reduksjon-i-ikke-smittsomme-sykdommer-nasjonal-oppfolging-av-whos-mal/Publikasjoner/reduksjon-i-ikke-smittsomme-sykdommer%E2%80%93nasjonal-oppf%C3%B8lging-av-WHOs-m%C3%A5l.pdf.

3. Ministry of Health and Care Services. Folkehelsemeldingen: God helse - felles ansvar St. Meld. 34 (2012-2013) [Public Health Report: Good Health - a common responsibility, White Paper 34 (2012-2013]. Ministry of Health and Care Services,. 2013. Available from: http://www.regjeringen.no/pages/38307106/PDFS/STM201220130034000DDDPDFS.pdf.

4. Salomon J, Wang H, Freeman M, Vos T, Flaxman A, Lopez A, et al. Healthy life expectancy for 187 countries, 1990-2010: a systematic analysis for the Global Burden Disease Study 2010. Lancet. 2012;380:2144-62.

5. Cooper R, Strand BH, Hardy R, Patel KV, Kuh D. Physical capability in mid-life and survival over 13 years of follow-up: British birth cohort study. BMJ. 2014;348. DOI:10.1136/bmj.g2219.

6. World Health Organization. Global health risks. Mortality and burden of disease attributable to selected major risks. World Health Organization. 2009. Available from: http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf.

7. Omran AR. The epidemiologic transition. A theory of the epidemiology of population change. The Milbank Memorial Fund quarterly. 1971;49(4):509-38.

8. Global status report on noncommunicable diseases 2010. Alwan DA, ed. World Health Organization. 2011. Available from: http://whqlibdoc.who.int/publications/2011/9789240686458_eng.pdf?ua=1.

9. Bjartveit K. Statens helseundersøkelser - Fra tuberkolosekamp til mangesidig epidemiologisk virksomhet [The National Health Screening Service: From fight against tuberculosis to many-sided epidemiological activities]. Nor J Epidemiol. 1997;7(2):157-74.

10. The Norwegian Directorate of Health. Nasjonale Retningslinjer for individuell primærforebygging av hjerte- og karsykdommer. The Norwegian Directorate of Health. 2009. Available from: http://helsedirektoratet.no/publikasjoner/nasjonal-faglig-retningslinje-for-individuell-primerforebygging-av-hjerte-og-karsykdommer/Publikasjoner/IS-1550.pdf.

11. Bjartveit K, Foss OP, Gjervig T, Lund-Larsen PG. The cardiovascular disease study in Norwegian counties. Background and organization. Acta Med Scand Suppl. 1979;634:1-70.

12. Reikvam A, Hagen TP. Endringer i dødelighet av hjerteinfarkt [Changes in myocardial infarction mortality]. Tidsskr Nor Legeforen. 2011;131(5):468-70.

13. Norwegian Institute of Public Health. Folkehelserapporten [Public Health Report]. Norwegian Institute of Public Health. 2014. Available from: http://www.fhi.no/publikasjoner-og-haandboker/folkehelserapporten.

14. Lund KE, Lund M, Bryhni A. Tobakksforbruket hos kvinner og menn 1927–2007 [Tobacco consumption among men and women 1927-2007]. Tidsskr Nor Legeforen. 2009;129(18):1871-4.

15. Giovino GA. Epidemiology of tobacco use in the United States. Oncogene. 2002;21(48):7326-40.

16. Anderssen SA, Engeland A, Sogaard AJ, Nystad W, Graff-Iversen S, Holme I. Changes in physical activity behavior and the development of body mass index during the last 30 years in Norway. Scand J Med Sci Sports. 2008;18:309-17.

17. Holme I, Anderssen SA. Fysisk aktivitet, røyking og dødelighet hos menn som deltok i Oslo-undersøkelsene i 1972 og 2000 [Physical activity, smoking and mortality among men who participated in the Oslo studies of 1972 and 2000]. Tidsskr Nor Legeforen. 2014;134(18):1743-8. DOI:10.4045/tidsskr.14.0073.

18. Sedentary Behaviour Research Network. Letter to the editor: standardized use of the terms "sedentary" and "sedentary behaviours". Appl Physiol Nutr Metab. 2012;37:540-2.

19. Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U, et al. Global physical activity levels: surveillance progress, pitfalls, and prospects. Lancet. 2012;380(9838):247-57.

20. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet. 2012;380(9838):219-29. DOI:10.1016/S0140-6736(12)61031-9.

21. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Physical Activity and Public Health. Updated Recommendation for Adults From the American College of Sports Medicine and the American Heart Association. Journal of the American Heart Association, Circulation. 2007;116(9):1081-93.

22. Warburton DE, Charlesworth S, Ivey A, Nettlefold L, Bredin SS. A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. Int J Behav Nutr Phys Act. 2010;7:39.

23. Wijndaele K, Healy GN, Dunstan DW, Barnett AG, Salmon J, Shaw JE, et al. Increased cardiometabolic risk is associated with increased TV viewing time. Med Sci Sports Exerc. 2010;42(8):1511-8.

24. Sulo G, Igland J, Nygard O, Vollset SE, Ebbing M, Tell GS. Favourable trends in incidence of AMI in Norway during 2001-2009 do not include younger adults: a CVDNOR project. Eur J Prev Cardiol. 2013. DOI:10.1177/2047487313495993.

25. Warren JM, Ekelund U, Besson H, Mezzani A, Geladas N, Vanhees L. Assessment of physical activity - a review of methodologies with reference to epidemiological research: a report of the exercise physiology section of the European Association of Cardiovascular Prevention and Rehabilitation. Eur J Cardiov Prev R. 2010;17(2):127-39.

26. Ministries. Handlingsplan for fysisk aktivitet 2005-2009: Sammen for fysisk aktivitet [The Action Plan on Physical Activity 2005-2009: Working together for physical activity]. Ministries. 2004. Available from: http://www.regjeringen.no/Upload/HOD/Vedlegg/Handlingsplan_2005-2009.pdf.

27. Hansen BH, Kolle E, Dyrstad SM, Holme I, Anderssen SA. Accelerometer-Determined Physical Activity in Adults and Older People. Med Sci Sports Exerc. 2012;44(2):266-72.

28. Bjartveit K, Wøien G. Risikofaktorer for hjerte-karsykdom i Norge: Resultater fra undersøkelser i 18 fylker [Cardiovascular disease risk factors in Norway - Results from surveys in 18 counties]. National Health Screening Service. Oslo: 1997.

29. Wøien G, Øyen O, Graff-Iversen S. 22 år med hjerte- og karundersøkelser i norske fylker: Bør vi være tilfreds med den utviklingen risikofaktorene har hatt? [22 years of cardiovascular surveys in Norwegian counties. Is the development in risk factors satisfactory?]. Nor J Epidemiol. 1997;7(2):255-66.

30. Norwegian Institute of Public Health. Norgeshelsa [Norhealth]. Norwegian Institute of Public Health; [cited 2014 April 10.]. Available from: http://norgeshelsa.no.

31. Wang H, Dwyer-Lindgren L, Lofgren KT, Rajaratnam JK, Marcus JR, Levin-Rector A, et al. Age-specific and sex-specific mortality in 187 countries, 1970-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012;380(9859):2071-94.

32. World Health Organization. World Health Statistics 2014. World Health Organization. Available from: http://apps.who.int/iris/bitstream/10665/112738/1/9789240692671_eng.pdf?ua=1.

33. Poulain M, Pes GM, Grasland C, Carru C, Ferrucci L, Baggio G, et al. Identification of a geographic area characterized by extreme longevity in the Sardinia island: the AKEA study. Exp Gerontol. 2004;39(9):1423-9.

34. Poulain M. Exceptional longevity in Okinawa: A plea for in-depth validation. Demographic Research. 2011;25(7):245-84.

35. Panagiotakos DB, Chrysohoou C, Siasos G, Zisimos K, Skoumas J, Pitsavos C, et al. Sociodemographic and lifestyle statistics of oldest old people (>80 years) living in Ikaria island: the Ikaria study. Cardiology Research and Practice. 2011:7p. DOI:10.4061/2011/679187.

36. Fraser GE, Shavlik DJ. Ten years of life: Is it a matter of choice? Arch Intern Med. 2001;161(13):1645-52.

37. Poulain M, Pes G, Salaris L. A Population Where Men Live As Long As Women: Villagrande Strisaili, Sardinia. Journal of Aging Research. 2011:10p. DOI:10.4061/2011/153756.

38. Buettner D. Blue Zones - Lessons for living longer from the people who've lived the longest. Washington, D.C.: National Geographic; 2008.

39. Statistics Norway. Levealder [Life expectancy]. Statistics Norway; 2013 [cited 2014 June 06.]. Available from: http://www.ssb.no/en/befolkning/statistikker/dode.

40. Kvaavik E, Batty GD, Ursin G, Huxley R, Gale CR. Influence of individual and combined health behaviors on total and cause-specific mortality in men and women: The United Kingdom health and lifestyle survey. Arch Intern Med. 2010;170(8):711-8.

41. Franco OH, de Laet C, Peeters A, Jonker J, Mackenbach J, Nusselder W. Effects of physical activity on life expectancy with cardiovascular disease. Arch Intern Med. 2005;165(20):2355-60.

42. Crimmins EM, Preston SH, Chohen B. Explaining divergent levels of longevity in high-income countries. Washington, DC: National Academies Press; 2011.

43. The Norwegian Directorate of Health. Vunne kvalitetsjusterte (QALYs) ved fysisk aktivitet. The Norwegian Directorate of Health. 2010. Available from: http://www.helsedirektoratet.no/publikasjoner/vunne-kvalitetsjusterte-levear-qalys-ved-fysisk-aktivitet/Publikasjoner/vunne-kvalitetsjusterte-levear-qalys-ved-fysisk-aktivitet.pdf.

44. Depp CA, Jeste DV. Definitions and predictors of successful aging: a comprehensive review of larger quantitative studies. Am J Geriatr Psychiatry. 2006;14(1):6-20.

45. Willcox BJ, Willcox DC, Ferrucci L. Secrets of healthy aging and longevity from exceptional survivors around the globe: lessons from octogenarians to supercentenarians. J Gerontol A Biol Sci Med Sci. 2008;63(11):1181-5.

46. Cicero. Cato Maior de Senectute. Translated to Norwegian by Mørland H.: Aschehoug; 1971.

47. Sogn og Fjordane County Council. Fylkesspegelen [County statistics]. Sogn og Fjordane County Council; 2013 [cited 2013 Jan 04.]. Available from: http://www.sfj.no/cmssff/cmspublish.nsf/pages/Statistikk_og_analyse.

48. Office for National Statistics. Population density. Office for National Statistics; 2013 [cited 2014 May 12.]. Available from: http://www.ons.gov.uk/ons/datasets-and-tables/index.html?pageSize=50&sortBy=none&sortDirection=none&newquery=density.

49. Statistics Norway. Befolkningsstatistikk - Ekteskap og Skilsmisser [Population Statistics - Marriage and Divorce]. Statistics Norway; 2012 [cited 2013 Jan 04.]. Available from: http://www.ssb.no/ekteskap/.

50. Statistics Norway. Befolkningens utdanningsnivå [Population's level of education]. Statistics Norway; 2013 [cited 2014 June 22.]. Available from: www.ssb.no/en/utdanning/statistikker/utniv.

51. Statistics Norway. Registrerte arbeidsledige [Registered unemployed]. Statistics Norway; 2013 [cited 2014 June 22.]. Available from: www.ssb.no/arbeid-og-lonn/statistikker/regledig.

52. Kringlen E, Torgersen S, Cramer V. Mental illness in a rural area: a Norwegian psychiatric epidemiological study. Soc Psychiatry Psychiatr Epidemiol. 2006;41(9):713-9.

53. Statistics Norway. Statistisk årbok [Statistics yearbook]. Statistics Norway. 2013. Available from: http://www.ssb.no/befolkning/artikler-og-publikasjoner/_attachment/140702?_ts=143c3c6bff8.

54. Norwegian Institute of Public Health. Folkehelsebarometeret [Public Health Profile]. Norwegian Institute of Public Health; 2013 [cited 2013 Jan 04.]. Available from: http://khp.fhi.no/.

55. Graff-Iversen S, Selmer R, Sørensen M, Skurtveit S. Occupational Physical Activity, Overweight, and Mortality: A Follow-up Study of 47,405 Norwegian Women and Men. Res Q Exercise Sport. 2007;78(3):151-61.

56. World Health Organization. Global Atlas on cardiovascular disease prevention and control. Mendis S, Puska P, Norrving B, ed. World Health Organization. 2011. Available from: http://whqlibdoc.who.int/publications/2011/9789241564373_eng.pdf?ua=1.

57. Yusuf S, Hawken S, Ounpuu S, Bautista L, Franzosi MG, Commerford P, et al. Obesity and the risk of myocardial infarction in 27,000 participants from 52 countries: a case-control study. Lancet. 2005;366(9497):1640-9.

58. Blair SN, Cheng Y, Holder JS. Is physical activity or physical fitness more important in defining health benefits? Med Sci Sports Exerc. 2001;33(6 Suppl):379-99.

59. Lee DC, Blair SN, Jackson AS. Cardiorespiratory fitness, body composition, and all-cause and cardiovascular disease mortality in men. Am J Clin Nutr. 1999;69:373-80.

60. Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet. 2004;364(9438):937-52.

61. World Health Organization. Prevention of Cardiovascular Disease: Guidelines for asseessment and management of cardiovascular risk. World Health Organization. 2007. Available from: http://whqlibdoc.who.int/publications/2007/9789241547178_eng.pdf?ua=1.

62. Meyer HE, Tverdal A. Development of body weight in the Norwegian population. Prostag Leukotr Ess. 2005;73(1):3-7.

63. Midthjell K LCMY, Langhammer A, Krogstad S, Holmen TL, Hveem K, Colaguri S, Holmen J. Trends in overweight and obesity over 22 years in a large adult population: the HUNT Study, Norway. Clinical Obesity. 2013;3:12-20. DOI:10.1111/cob.12009.

64. Jacobsen BK, Njolstad I, Thune I, Wilsgaard T, Lochen ML, Schirmer H. Increase in weight in all birth cohorts in a general population: The Tromso Study, 1974-1994. Arch Intern Med. 2001;161(3):466-72.

65. Flegal KM, Carroll MD, Kit BK, Ogden CL. Prevalence of Obesity and Trends in the Distribution of Body Mass Index Among US Adults, 1999-2010. JAMA. 2012;307(5):491-7.

66. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Rep. 1985;100(2):126-31.

67. Aadahl M, Kjaer M, Jorgensen T. Associations between overall physical activity level and cardiovascular risk factors in an adult population. Eur J Epidemiol. 2007;22(6):369-78.

68. Ekblom-Bak E, Hellenius ML, Ekblom O, Engstrom LM, Ekblom B. Independent associations of physical activity and cardiovascular fitness with cardiovascular risk in adults. Eur J Cardiov Prev R. 2010;17(2):175-80.

69. Vuori I. Physical activity and cardiovascular disease prevention in Europe: An update. Kinesiology. 2010;42(1):5-15.

70. Hu G, Tuomilehto J, Silventoinen K, Barengo N, Jousilahti P. Joint effects of physical activity, body mass index, waist circumference and waist-to-hip ratio with the risk of cardiovascular disease among middle-aged Finnish men and women. Eur Heart J. 2004;25(24):2212-9.

71. Luke A, Dugas LR, Durazo-Arvizu RA, Cao G, Cooper RS. Assessing physical activity and its relationship to cardiovascular risk factors: NHANES 2003-2006. BMC Public Health. 2011;11:387.

72. The Norwegian Directorate of Health. Anbefalinger om kosthold, ernæring og fysisk aktivitet [Recomended guidelines for diet, nutrition and physical activity]. The Norwegian Directorate of Health. 2014. Available from: http://www.helsedirektoratet.no/publikasjoner/anbefalinger-om-kosthold-ernering-og-fysisk-aktivitet/Publikasjoner/anbefalinger-om-kosthold-ernering-og-fysisk-aktivitet.pdf.

73. World Health Organization. Global recommendations on physical activity for health. World Health Organization. 2010. Available from: http://whqlibdoc.who.int/publications/2010/9789241599979_eng.pdf.

74. Leitzmann MF, Park Y, Blair A, Ballard-Barbash R, Mouw T, Hollenbeck AR, et al. Physical activity recommendations and decreased risk of mortality. Arch Intern Med. 2007;167(22):2453-60.

75. Ford ES, Caspersen CJ. Sedentary behaviour and cardiovascular disease: a review of prospective studies. Int J Epidemiol. 2012;41(5):1338-53.

76. Dunstan DW, Thorp AA, Healy GN. Prolonged sitting: is it a distinct coronary heart disease risk factor? Curr Opin Cardiol. 2011;26(5):412-9.

77. Veerman JL, Healy GN, Cobiac LJ, Vos T, Winkler EA, Owen N, et al. Television viewing time and reduced life expectancy: a life table analysis. Br J Sports Med. 2012;46(13):927-30. DOI:doi:10.1136/2 of 4 bjsm.2011.085662.

78. Aadland E, Andersen JR, Anderssen SA, Kvalheim OM. Physical activity versus sedentary behavior: associations with lipoprotein particle subclass concentrations in healthy adults. PLoS ONE. 2013;8(12):e85223. DOI:10.1371/journal.pone.0085223.

79. Holtermann A, Mork P, Nilsen TL. Hours lying down per day and mortality from all-causes and cardiovascular disease: the HUNT Study, Norway. Eur J Epidemiol. 2014;29(8):559-65. DOI:10.1007/s10654-014-9939-7.

80. Borodulin K, Laatikainen T, Juolevi A, Jousilahti P. Thirty-year trends of physical activity in relation to age, calendar time and birth cohort in Finnish adults. Eur J Public Health. 2008;18(3):339-44.

81. Bauman A, Armstrong T, Davies J, Owen N, Brown W, Bellew B, et al. Trends in physical activity participation and the impact of integrated campaigns among Australian adults, 1997-99. Aust NZ J Publ Heal. 2003;27(1):76-9.

82. Knuth AG, Hallal PC. Temporal trends in physical activity: A systematic review. J Phys Act Health. 2009;6(5):548-59.

83. Craig CL, Russell SJ, Cameron C, Bauman A. Twenty-year trends in physical activity among Canadian adults. Can J Public Health. 2004;95(1):59-63.

84. Stamatakis E, Ekelund U, Wareham NJ. Temporal trends in physical activity in England: the Health Survey for England 1991 to 2004. Prev Med. 2007;45(6):416-23.

85. Søgaard AJ, Bø K, Klungland M, Jacobsen BK. En oversikt over norske studier - hvor mye beveger vi oss i fritiden? [A review of Norwegian studies-how much do we exercise during our leisure time?]. Tidsskr Nor Legeforen. 2000;120(28):3439-46.

86. Krokstad S, Knudtsen MS, ed. Folkehelse i endring - Helseundersøkelsen i Nord-Trøndelag [Public health development: The HUNT Study, Norway]. HUNT forskningssenter. 2011. Available from: http://www.ntnu.no/documents/10304/1130562/folkehelse-i-endring-huntrapport-2011.pdf.

87. Aires N, Selmer R, Thelle D. The validity of self-reported leisure time physical activity, and its relationship to serum cholesterol, blood pressure and body mass index. A population based study of 332,182 men and women aged 40-42 years. Eur J Epidemiol. 2003;18(6):479-85.

88. The Norwegian Directorate of Health. Fysisk aktivitet blant voksne og eldre i Norge - Resultater fra en kartlegging i 2008 og 2009 [Physical Activity among Adults and Elderly in Norway]. The Norwegian Directorate of Health. Oslo: 2009 IS-1754.

89. Graff-Iversen S, Skurtveit S, Nybo A, Ross GB. Utviklingen i kroppsarbeid hos norske 40–42-åringer i tiden 1974–94 [Occupational physical activity: trends among Norwegian men and women aged 40–42 years, 1974–94]. Tidsskr Nor Legeforen. 2001;121(22):2584-8.

90. Church TS, Thomas DM, Tudor-Locke C, Katzmarzyk PT, Earnest CP, Rodarte RQ, et al. Trends over 5 decades in U.S. occupation-related physical activity and their associations with obesity. PLoS One. 2011;6(5):e19657 doi:10.1371/journal.pone.0019657.

91. Anderssen SA, Andersen LB. Fysisk aktivitetsnivå i Norge 2003: Data basert på spørreskjemaet "International Physical Activity Questionnaire" [Level of Physical Activity in Norway 2003]. The Norwegian Directorate of Health and Care Services. Oslo: 2004 IS-1254.

92. The Norwegian Directorate of Health. Omnibus survey. The Norwegian Directorate of Health. 2008.

93. Finucane MM, Stevens GA, Cowan MJ, Danaei G, Lin JK, Paciorek CJ, et al. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. Lancet. 2011;377(9765):557-67.

94. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2014;384(9945):766-81.

95. Gelber RP, Gaziano JM, Orav EJ, Manson JE, Buring JE, Kurth T. Measures of Obesity and Cardiovascular Risk Among Men and Women. J Am Coll Cardio. 2008;52(8):605-15. DOI:doi: 10.1016/j.jacc.2008.03.066.

96. Prospective Studies Collaboration. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. Lancet. 2009;373(9669):1083-96. DOI:10.1016/s0140-6736(09)60318-4.

97. McAllister EJ, Dhurandhar NV, Keith SW, Aronne LJ, Barger J, Baskin M, et al. Ten putative contributors to the obesity epidemic. Crit Rev Food Sci Nutr. 2009;49(10):868-913. DOI:10.1080/10408390903372599.

98. Jenum AK, Graff-Iversen S, Selmer R, Sogaard AJ. Risikofaktorer for hjerte- og karsykdom og diabetes gjennom 30 år [Risk factors for cardiovascular disease and diabetes through three decades]. Tidsskr Nor Legeforen. 2007;127(19):2532-6.

99. Flegal KM, Carroll MD, Ogden CL, Curtin LR. Prevalence and trends in obesity among US adults, 1999-2008. JAMA. 2010;303(3):235-41.

100. Flegal KM. Epidemiologic aspects of overweight and obesity in the United States. Physiol Behav. 2005;86(5):599-602.

101. Flegal KM, Carroll MD, Kuczmarski RJ, Johnson CL. Overweight and obesity in the United States: prevalence and trends, 1960-1994. Int J Obesity. 1998;22(1):39-47.

102. Graff-Iversen S, Øien H. Kroppsmasseindeks og vektutvikling: Hvilke forskjeller er det mellom kjønnene? [Occupational physical activity and overweight: what are the associations?]. Nor J Epidemiol. 2000;10(1):87-94.

103. Jha P, Peto R. Global effects of smoking, of quitting, and of taxing tobacco. N Engl J Med. 2014;370(1):60-8.

104. Statistics Norway. Røykevaner [Smoking habits]. Statistics Norway; 2013 [cited 2014 May 18.]. Available from: http://www.ssb.no/royk.

105. Mancia G, Fagard R, Narkiewicz K, Redon J, Zanchetti A, Bohm M, et al. 2013 ESH/ESC Guidelines for the management of arterial hypertension: the Task Force for the management of arterial hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). J Hypertens. 2013;31(7):1281-357. DOI:10.1097/01.hjh.0000431740.32696.cc.

106. Danaei G, Finucane MM, Lin JK, Singh GM, Paciorek CJ, Cowan MJ, et al. National, regional, and global trends in systolic blood pressure since 1980: systematic analysis of health examination surveys and epidemiological studies with 786 country-years and 5.4 million participants. Lancet. 2011;377(9765):568-77.

107. Graff-Iversen S, Jenum AK, Grotvedt L, Bakken B, Selmer RM, Sogaard AJ. Risikofaktorer for hjerteinfarkt, hjerneslag og diabetes i Norge [Risk factors for myocardial infarction, stroke and diabetes in Norway]. Tidsskr Nor Legeforen. 2007;127(19):2537-41.

108. Petursson H, Sigurdsson JA, Bengtsson C, Nilsen TI, Getz L. Is the use of cholesterol in mortality risk algorithms in clinical guidelines valid? Ten years prospective data from the Norwegian HUNT 2 study. J Eval Clin Pract. 2012;18(4):927-8.

109. Farzadfar F, Finucane MM, Danaei G, Pelizzari PM, Cowan MJ, Paciorek CJ, et al. National, regional, and global trends in serum total cholesterol since 1980: systematic analysis of health examination surveys and epidemiological studies with 321 country-years and 3.0 million participants. Lancet. 2011;377(9765):578-86.

110. Baptista F, Santos DA, Silva AM, Mota J, Santos R, Vale S, et al. Prevalence of the Portuguese population attaining sufficient physical activity. Med Sci Sports Exerc. 2012;44(3):466-73.

111. Hagstromer M, Troiano RP, Sjostrom M, Berrigan D. Levels and patterns of objectively assessed physical activity-a comparison between Sweden and the United States. Am J Epidemiol. 2010;171(10):1055-64.

112. Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJ, Martin BW, et al. Correlates of physical activity: why are some people physically active and others not? Lancet. 2012;380(9838):258-71.

113. Bauman AE, Sallis JF, Dzewaltowski DA, Owen N. Toward a better understanding of the influences on physical activity: the role of determinants, correlates, causal variables, mediators, moderators, and confounders. Am J Prev Med. 2002;23(2 Suppl):5-14.

114. Sallis JF, Owen N, Fisher EB. Ecological models of health behavior. In: Glanz K, Rimer BK, Viswanath K, editors. Health behavior and helath education: theory, research, and practice. 4th ed. San Francisco, CA: Jossey-Bass; 2008. p. 465-86.

115. Hamer M, Kivimaki M, Steptoe A. Longitudinal patterns in physical activity and sedentary behaviour from mid-life to early old age: a substudy of the Whitehall II cohort. J Epidemiol Commun H. 2012;66(12):1110-5.

116. Trost SG, Owen N, Bauman AE, Sallis JF, Brown W. Correlates of adults' participation in physical activity: review and update. Med Sci Sports Exerc. 2002;34(12):1996-2001.

117. Morseth B, Jorgensen L, Emaus N, Jacobsen BK, Wilsgaard T. Tracking of leisure time physical activity during 28 yr in adults: the Tromso study. Med Sci Sports Exerc. 2011;43(7):1229-34.

118. van Stralen MM, De Vries H, Mudde AN, Bolman C, Lechner L. Determinants of initiation and maintenance of physical activity among older adults: a literature review. Health Psychol Rev. 2009;3(2):147-207. DOI:10.1080/17437190903229462.

119. Kirjonen J, Telama R, Luukkonen R, Kaaria S, Kaila-Kangas L, Leino-Arjas P. Stability and prediction of physical activity in 5-, 10-, and 28-year follow-up studies among industrial employees. Scand J Med Sci Sports. 2006;16(3):201-8.

120. Kvaavik E, Meyer HE, Tverdal A. Food habits, physical activity and body mass index in relation to smoking status in 40-42 year old Norwegian women and men. Prev Med. 2004;38(1):1-5.

121. Heath GW, Parra DC, Sarmiento OL, Andersen LB, Owen N, Goenka S, et al. Evidence-based intervention in physical activity: lessons from around the world. Lancet. 2012;380(9838):272-81.

122. Wendel-Vos W, Droomers M, Kremers S, Brug J, van Lenthe F. Potential environmental determinants of physical activity in adults: a systematic review. Obes Rev. 2007;8(5):425-40. DOI:10.1111/j.1467-789X.2007.00370.x.

123. Saelens BE, Handy SL. Built environment correlates of walking: a review. Med Sci Sports Exerc. 2008;40(7 Suppl):S550-66.

124. Van Holle V, Deforche B, Van Cauwenberg J, Goubert L, Maes L, Van de Weghe N, et al. Relationship between the physical environment and different domains of physical activity in European adults: a systematic review. BMC Public Health. 2012;12:807.

125. Hansen BH, Ommundsen Y, Holme I, Kolle E, Anderssen SA. Correlates of objectively measured physical activity in adults and older people: a cross-sectional study of population-based sample of adults and older people living in Norway. Int J Publ Health. 2013. DOI:10.1007/s00038-013-0472-3.

126. Kirk MA, Rhodes RE. Occupation Correlates of Adults' Participation in Leisure-Time Physical Activity: A Systematic Review. Am J Prev Med. 2011;40(4):476-85.

127. Hankinson AL, Daviglus ML, Bouchard C, Carnethon M, Lewis CE, Schreiner PJ, et al. Maintaining a High Physical Activity Level Over 20 Years and Weight Gain. JAMA. 2010;304(23):2603-10. DOI:10.1001/jama.2010.1843.

128. Hanson HM, Ashe MC, McKay HA, Winters M. Intersection between the Built and Social Environments and Older Adults' Mobility: An Evidence Review. National Collaborating Centre for Environmental Health. 2012.

129. Ainsworth BE, Caspersen CJ, Matthews CE, Masse LC, Baranowski T, Zhu W. Recommendations to improve the accuracy of estimates of physical activity derived from self report. J Phys Act Health. 2012;9 Suppl 1:S76-84.

130. Sallis JF, Saelens BE. Assessment of physical activity by self-report: Status, limitations, and future directions. Res Q Exercise Sport. 2000;71(2 Suppl):1-14.

131. Lochen ML, Rasmussen K. The Tromso study: physical fitness, self reported physical activity, and their relationship to other coronary risk factors. J Epidemiol Commun H. 1992;46(2):103-7.

132. Haakstad.L.A.H., Bø K. Fitness and physical activity in Norwegian adults. Advances in Physiotherapy. 2007;9:89-96.

133. Shephard RJ. Limits to the measurement of habitual physical activity by questionnaires. Br J Sports Med. 2003;37(3):197-206. DOI:doi: 10.1136/bjsm.37.3.197.

134. Freedson PS, Miller K. Objective monitoring of physical activity using motion sensors and heart rate. Res Q Exercise Sport. 2000;71(2 Suppl):21-9.

135. Hagstromer M, Oja P, Sjostrom M. Physical activity and inactivity in an adult population assessed by accelerometry. Med Sci Sports Exerc. 2007;39(9):1502-8.

136. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. Med Sci Sports Exerc. 2008;40(1):181-8.

137. Matthews CE, Hagstromer M, Pober DM, Bowles HR. Best practices for using physical activity monitors in population-based research. Med Sci Sports Exerc. 2012;44(1 Suppl 1):S68-76.

138. Prince SA, Adamo KB, Hamel ME, Hardt J, Connor Gorber S, Tremblay M. A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. Int J Behav Nutr Phys Act. 2008;5:56. DOI:10.1186/1479-5868-5-56.

139. Dyrstad SM, Hansen BH, Holme IM, Anderssen SA. Comparison of Self-reported versus Accelerometer-Measured Physical Activity. Med Sci Sports Exerc. 2014;46(1):99-106. DOI:10.1249/MSS.0b013e3l82a0595f.

140. Vågane L, Brechan I, Hjorthol R. Den nasjonale reisevaneundersøkelsen 2009 - nøkkelrapport [2009 Norwegian National Travel Survey - key results]. Institute of Transport Economics. 2011. Available from: https://www.toi.no/getfile.php/Publikasjoner/T%C3%98I%20rapporter/2011/1130-2011/1130-2011-el.pdf.

141. Hansen BH, Holme I, Anderssen SA, Kolle E. Patterns of objectively measured physical activity in normal weight, overweight, and obese individuals (20-85 years): a cross-sectional study. PLoS ONE. 2013;8(1):e53044. DOI:doi:10.1371/journal.pone.0053044.

142. Bjartveit K, Foss OP, Gjervig T. The cardiovascular disease study in Norwegian counties. Results from first screening. Acta Med Scand Suppl. 1983;675:1-184.

143. Wilhelmsen L, Tibblin G, Aurell M, Bjure J, Ekstrom-Jodal B, Grimby G. Physical activity, physical fitness and risk of myocardial infarction. Advances in cardiology. 1976;18(0):217-30.

144. Saltin B, Grimsby G. Physiological analysis of middle-aged and old former athletes. Circulation. 1968;38:1104-15.

145. Graff-Iversen S, Anderssen SA, Holme IM, Jenum AK, Raastad T. Two short questionnaires on leisure-time physical activity compared with serum lipids, anthropometric measurements and aerobic power in a suburban population from Oslo, Norway. Eur J Epidemiol. 2008;23(3):167-74.

146. Norwegian Institute of Public Health. CONOR web page. Norwegian Institute of Public Health; 2010 [cited 2013 Jan 04.]. Available from:

http://www.fhi.no/eway/default.aspx?pid=238&trg=MainLeft_5853&MainArea_5811=5853:0:15,2818:1:0:0:::0:0&MainLeft_5853=5825:56612::1:5857:2:::0:0.

147. Søgaard AJ, Gustad T, Bjertness E, Tell G, Schei B, Emaus N, et al. Urban-rural differences in distal forearm fractures: Cohort Norway. Osteoporos Int. 2007;18(8):10p. DOI:10.1007/s00198-007-0353-9.

148. Metzger JS, Catellier DJ, Evenson KR, Treuth MS, Rosamond WD, Siega-Riz AM. Patterns of objectively measured physical activity in the United States. Med Sci Sports Exerc. 2008;40(4):630-8.

149. Becker W, Lyhne N, Pedersen AN, Aro A, Fogelholm M, Thorsdottir I, et al. Nordic nutrition recommendations 2004 - integrating nutririon and physical activity. Scand J Nutr. 2006;48(4):178-87.

150. Balke B. [Optimum physical working capacity, its measurement and change as a result of the working fatigue.]. Arbeitsphysiologie. 1954;15(4):311-23.

151. Edvardsen E, Hansen BH, Holme IM, Dyrstad SM, Anderssen SA. Reference Values for Cardiorespiratory Response and Fitness on the treadmill in a 20-85-year-old Population. Chest. 2013;144(1):241-8. DOI:10.1378/chest.12-1458.

152. Tonstad S, Graff-Iversen S. Action levels for obesity treatment in 40 to 42-y-old men and women compared with action levels for prevention of coronary heart disease. Int J Obes Relat Metab Disord. 2001;25(11):1698-704.

153. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. Lancet. 1986;i:307-10.

154. Lund-Larsen PG. Blodtrykk målt med kvikksølvmanometer og med Dinamap under feltforhold - en sammenligning [Blood pressure measured with a sphygmomanometer and with Dinamap under field conditions – a comparison]. Nor J Epidemiol. 1997;7(2):235-41.

155. Tverdal A. Betydelig nedgang i blodtrykksnivå etter 1996 – faktum eller artefakt? [Significant decline in blood pressure levels after 1996-fact or artefact?]. Tidsskr Nor Legeforen. 2001;121(15):1821-5.

156. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem. 1972;18(6):499-502.

157. Linting M, Meulman JJ, Groenen PJ, van der Koojj AJ. Nonlinear principal components analysis: introduction and application. Psychological methods. 2007;12(3):336-58. DOI:10.1037/1082-989X.12.3.336.

158. Brownson RC, Baker EA, Housemann RA, Brennan LK, Bacak SJ. Environmental and policy determinants of physical activity in the United States. Am J Public Health. 2001;91(12):1995-2003.

159. The Norwegian Directorate of Health. Fysisk aktivitetsnivå blant voksne og eldre i Norge - Oppdaterte analyser basert på nye nasjonale anbefalinger i 2014. [Physical activity levels in Adults and Older People in Norway - Updated analyzes based on new national guidelines in 2014]. The Norwegian Directorate of Health. 2014. Available from: http://helsedirektoratet.no/publikasjoner/fysisk-aktivitetsniva-blant-voksne-og-eldre-i-norge/Documents/IS%202183%20Rapport%20oppdaterte%20anbefalinger%20fysisk%20aktivitet%20060514b.pdf.

160. Flegal KM. The conundrum of smoking cessation and weight gain. Prev Med. 2012;54(3–4):193-4. DOI:10.1016/j.ypmed.2012.01.015.

161. Droyvold WB, Nilsen TI, Kruger O, Holmen TL, Krokstad S, Midthjell K, et al. Change in height, weight and body mass index: Longitudinal data from the HUNT Study in Norway. Int J Obesity. 2006;30(6):935-9.

162. Wilsgaard T, Arnesen E. Body mass index and coronary heart disease risk score: the Tromso study, 1979 to 2001. Ann Epidemiol. 2007;17(2):100-5.

163. World Health Organization. Physical Status: the use and interpretation of anthropometry. Technical Report Series No. 854. World Health Organization. 1995. Available from: http://whqlibdoc.who.int/trs/WHO_TRS_854.pdf?ua=1.

164. Droyvold WB, Midthjell K, Nilsen TI, Holmen J. Change in body mass index and its impact on blood pressure: a prospective population study. Int J Obesity. 2005;29(6):650-5.

165. Norwegian Institute of Public Health. Reseptregisteret [Norwegian Prescription Database]. Norwegian Institute of Public Health; 2013 [cited 2013 July 07.]. Available from: http://www.reseptregisteret.no/.

166. Durstine JL, Grandjean PW, Davis PG, Ferguson MA, Alderson NL, DuBose KD. Blood lipid and lipoprotein adaptations to exercise: a quantitative analysis. Sports Med. 2001;31(15):1033-62.

167. Aspenes ST, Nilsen TIL, Skaug E-A, Bertheussen GF, Ellingsen Ø, Vatten L, et al. Peak Oxygen Uptake and Cardiovascular Risk Factors in 4631 Healthy Women and Men. Med Sci Sports Exerc. 2011;43(8):1465-73.

168. Lamon-Fava S, Wilson PW, Schaefer EJ. Impact of body mass index on coronary heart disease risk factors in men and women. The Framingham Offspring Study. Arterioscler Thromb Vasc Biol. 1996;16(12):1509-15.

169. Telama R, Yang X, Viikari J, Valimaki I, Wanne O, Raitakari O. Physical activity from childhood to adulthood: a 21-year tracking study. Am J Prev Med. 2005;28(3):267-73.

170. Malina RM. Physical activity and fitness: pathways from childhood to adulthood. Am J Hum Biol. 2001;13(2):162-72. DOI:10.1002/1520-6300(200102/03)13:2<162::AID-AJHB1025>3.0.CO;2-T.

171. Ekelund U, Brage S, Besson H, Sharp S, Wareham NJ. Time spent being sedentary and weight gain in healthy adults: reverse or bidirectional causality? Am J Clin Nutr. 2008;88(3):612-7.

172. Duncan MJ, Spence JC, Mummery WK. Perceived environment and physical activity: a meta-analysis of selected environmental characteristics. Int J Behav Nutr Phys Act. 2005;2:11. DOI:10.1186/1479-5868-2-11.

173. Sundquist K, Eriksson U, Kawakami N, Skog L, Ohlsson H, Arvidsson D. Neighborhood walkability, physical activity, and walking behavior: the Swedish Neighborhood and Physical Activity (SNAP) study. Soc Sci Med. 2011;72(8):1266-73. DOI:10.1016/j.socscimed.2011.03.004.

174. King AC, Castro C, Wilcox S, Eyler AA, Sallis JF, Brownson RC. Personal and environmental factors associated with physical inactivity among different racial-ethnic groups of U.S. middle-aged and older-aged women. Health Psychol. 2000;19(4):354-64.

175. Corder K, Brage S, Ekelund U. Accelerometers and pedometers: methodology and clinical application. Curr Opin Nutr Metab Care. 2007;10(5):597-603.

176. Hansen BH. Physical activity in adults and older people [Doctoral thesis]. Oslo: Norwegian School of Sport Sciences; 2013.

177. Hutcheon JA, Chiolero A, Hanley JA. Random measurement error and regression dilution bias. BMJ. 2010;340:c2289. DOI:10.1136/bmj.c2289.

178. Helmerhorst HJ, Brage S, Warren J, Besson H, Ekelund U. A systematic review of reliability and objective criterion-related validity of physical activity questionnaires. Int J Behav Nutr Phys Act. 2012;9:103.

179. Gebel K, Bauman A, Owen N. Correlates of non-concordance between perceived and objective measures of walkability. Ann Behav Med. 2009;37(2):228-38. DOI:10.1007/s12160-009-9098-3.

180. Walk Score®. Walk Score. Walk Score®; 2014 [cited 2014 March 18.]. Available from: http://www.walkscore.com/professional/research.php.

181. Matthews SA, Moudon AV, Daniel M. Work group II: Using Geographic Information Systems for enhancing research relevant to policy on diet, physical activity, and weight. Am J Prev Med. 2009;36(4 Suppl):S171-6. DOI:10.1016/j.amepre.2009.01.011.

182. Bjartveit K, Stensvold I, Lund-Larsen PG, Gjervig T, Kruger O, Urdal P. Hjerte- og karundersøkelser i norske fylker: Bakgrunn og gjennomføring - Status 1986-90 for risikomønster blant 40-42-åringer i 14 fylker [Cardiovascular screenings in Norwegian counties. Background and implementation. Status of risk pattern during the period 1986-90 among persons aged 40-42 years in 14 counties]. Tidsskr Nor Legeforen. 1991;111(17):2063-72.

183. Søgaard AJ, Selmer R, Bjertness E, Thelle D. The Oslo Health Study: The impact of self-selection in a large, population-based survey. International Journal For Equity In Health. 2004;3(1):3.

184. Rose G. Sick individuals and sick populations. Int J Epidemiol. 2001;30(3):427-32.

Paper I

Level of physical activity, cardiorespiratory fitness and cardiovascular disease risk factors in a rural adult population in Sogn og Fjordane

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ABSTRACT

Background: Physical activity (PA) and high cardiorespiratory fitness (CRF) are associated with reduced risk of cardiovascular disease (CVD). Sogn og Fjordane County has the reputation of being the most healthy county in Norway. The level of PA and/or CRF may partly explain this health status. However, only one study with regional objectively measured PA data and one study with regional data on CRF currently exist. Thus, the aim of this study was to describe levels of PA, CRF and CVD risk factors in an adult population in the county of Sogn og Fjordane. ***Methods:*** In total, 314 (♀:178 ♂:136) 40-42-year-olds and 308 (♀:175 ♂:133) 53-55-year-olds participated in this cross-sectional study. PA was measured objectively by accelerometry, while CRF was measured directly. ***Results:*** There were no sex differences in total PA level. For the 40-42-year-olds, women spent 6.0 min/day [95% CI: –11.7 to –0.3] less participating in moderate PA compared to men. For the 53-55-year-olds, women were inactive for 36.0 min/day [95% CI: –55.2 to –16.8] less and they participated in light activity for 26.4 min/day [95% CI: 7.7 to 45.2] more than men. In total, 30.0% [95% CI: 24.8 to 35.2] of the 40-42-year-olds and 30.2% [95% CI: 25.0 to 35.4] of the 53-55-year-olds met the Norwegian recommendations for PA. CRF was 49.0 $ml·kg^{-1}·min^{-1}$ for men and 41.6 $ml·kg^{-1}·min^{-1}$ for women for the 40-42-year-olds. For 53-55-year-olds CRF was 41.2 $ml·kg^{-1}·min^{-1}$ for men and 33.9 $ml·kg^{-1}·min^{-1}$ for women. ***Conclusions:*** These results suggest that the level of PA and CRF are higher compared to other available data. This might explain the advantageous health status in Sogn og Fjordane.

BACKGROUND

Regular physical activity (PA) is related to important aspects of health and PA is associated with increased longevity (1) and reduced risk of cardiovascular disease (CVD) and its risk factors (1-3). Physical inactivity is the fourth leading contributing factor to death globally (4). Furthermore, high cardiorespiratory fitness (CRF) is related to lower levels of CVD risk factors (1,3) and CVD- and all-cause mortality (1,5). Due to the health benefits achieved by regular PA, health-enhancing PA recommendations have been issued both internationally (6) and nationally (7,8). Compliance with the PA recommendations has been associated with lower risk of death (9).

Monitoring PA levels is important for surveillance and assessment of the effectiveness of interventions or public health initiatives aimed at increasing PA (10). Assessments of PA have mainly been based upon self-administered questionnaires (11-16). Norwegian PA data show conflicting results (11,13,17,18). For instance, 68% of the Norwegians view themselves as physically active (19) and 33% to 61% reports participation in PA at least twice a week (18). PA is multidimensional and these conflicting results might be partly due to methodological weaknesses and poor assessment methods. Self-reported instruments are widely used, but these have numerous limitations with respect to difficulties in ascertaining the frequency, duration and intensity of PA, capturing all domains of PA, social desirability bias, recall bias and reactivity (10,12,20). Due to these limitations, objective assessment instruments, such as accelerometers, have been introduced to quantify PA (10,21). These motion devices are able to determine pattern and intensity of PA (10) and have been used in large population-based studies (13,22,23). In the Kan1 study, PA was assessed both by accelerometer and self-report in a representative population of Norwegian adults. Results showed that 18% of men and 22% of women met the objectively assessed PA recommendations. However, 43% of men and 32% of women met the recommendations when PA was measured by self-report (13). Similar findings are seen in Sweden and US were physical activity is measured both by self-report (24) and by accelerometry (22,23, 25) in large population samples.

Sogn og Fjordane County has Norway's longest living population. Life expectancy among men and women are respectively 78.2 and 83.5 years compared to a national average of 76.9 and 81.9 years (26). The county has a reputation of being the most healthy county in Norway (27) and is among the counties with lowest CVD mortality. In 2008 the county had 266 (men) and 153 (woman) deaths caused by CVD among every 100 000 persons, compared to 275 (men) and 163 (woman) nationally (28). High levels of PA and/or CRF may partly explain this advantageous health status in Sogn og Fjordane. However, only one study with regional objectively measured PA data (13) and one study with regional data on CRF currently exist (29). Thus, the aim of this study was to describe levels of objectively measured PA, directly measured CRF and CVD risk factors in an adult population in the county of Sogn og Fjordane. Based on knowledge of the association between PA, CRF and CVD risk factors, we hypothesized that the population of Sogn og Fjordane County would be more physically active and have higher CRF compared to the rest of Norway.

METHODS

Population

All men and women in three geographically close municipalities in Sogn og Fjordane County (Luster, Sogndal and Leikanger) aged 40-42-years (N=553) and 53-55-years (N=543) at baseline were invited to participate in the study.

The study was divided into two phases. In phase 1, PA was measured objectively by accelerometry between October 2008 and December 2009. Invitation was sent via mail and as a reminder in the case of no response, the subjects were contacted by phone and/or mail. When an informed consent was received, a questionnaire and an accelerometer were sent to the subjects via mail and returned after use in a prepaid envelope. In total, 314 (61%) 40-42-year-olds and 308 (62%) 53-55-year-olds participated in phase 1 (figure 1).

All subjects from phase 1 holding valid data on both questionnaire and accelerometry were considered eligible subjects for phase 2. From a random sample, 200 subjects in both age-groups were invited to participate in phase 2. In total, 107 (56%) 40-42-year-olds and 111 (62%) 53-55-year-olds participated in phase 2 (figure 1). In phase 2, CRF and CVD risk factors were measured. The physical examination was performed between March 2010 and September 2010. Tests were performed at Sogn og Fjordane University College. The same experienced test personnel performed all examinations, except for measurements of blood pressure and blood sampling, which were carried out by two experienced nurses. The subjects signed an informed consent and a health status declaration prior to testing.

The study was approved by the Regional Committee for Medical Research Ethics, the Norwegian Social Science Data Services AS and the Norwegian Tax Department.

Measures

Anthropometry

Height and weight for all subjects were self-reported through a questionnaire in phase 1. Furthermore, waist circumference was measured by anthropometric tape at midpoint between the lowest rib and crista iliaca after a normal expiration in phase 2. The mean value of three measurements was used in statistical analyses.

Blood pressure

Systolic (SBP) and diastolic (DBP) blood pressure were measured automatically using an Omron HEM-907 blood pressure monitor (Omron Healthcare, Inc, Vernon Hills, IL, US) for subjects attending phase 2. The subjects rested for five minutes and a cuff with appropriate size was placed on the left upper arm. Three repeated measures were taken at one-minute intervals. The mean value of the two last measurements was used in statistical analyses.

Blood analysis

Non-fasting intravenous blood-samples were taken from the antecubital vein for subjects attending phase 2. The samples were spun for 12 minutes at 3000 rpm within 60 minutes. The blood-samples were sent by overnight express mail and analyzed by the Department of Medical Biochemistry at Oslo University Hospital, Ullevaal (Norway). Total cholesterol (TC), high-density lipoprotein cholesterol (HDL-c), triglycerides (TG) and glucose were measured in serum using the Cobas Integra 800 analyzer from Roche (F. Hoffmann-La Roche Ltd, Basle, Switzerland). Low-density lipoprotein (LDL-c) was estimated from TC, HDL-c and TG by the Friedewald formula (30). Blood samples are missing from one subject in the 40-42-year-old-group and three subjects in the 53-55-year-old-group due to technical problems.

Cardiorespiratory fitness

For subjects attending phase 2, a CRF (maximal oxygen uptake (VO_{2max})) test was performed on a Woodway PPS 55 treadmill (Woodway GmbH, Weihlam Rhine, Germany) and oxygen uptake was measured with a Moxus metabolic analyzer (AEI Technologies, Inc. Naperville, IL, USA) with accompanying software (Max II). A modified Balke protocol was used (31). The protocol started with constant speed and progressing inclination (2%) every minute for the first 12 minutes, then speed was increased with 0.5 $km \cdot h^{-1}$ each minute until voluntary exhaustion. Before testing, a Polar heart rate (HR) monitor (Polar OY, Kempele, Finland) was fitted to the chest by an elastic strap. The subjects then had two to seven minutes of adaption to the treadmill (2.0-4.8 $km \cdot h^{-1}$). To collect expired air a Hans Rudolph Vmask (Hans Rudolph Inc, Kansas City, MO, USA), was attached to a Hans Rudolph two-way non re-breathable valve (HR 2700), fitted onto the subject, controlled for air tightness and connected to the metabolic analyzer. Depending on health status, the subjects performed two different test protocols.

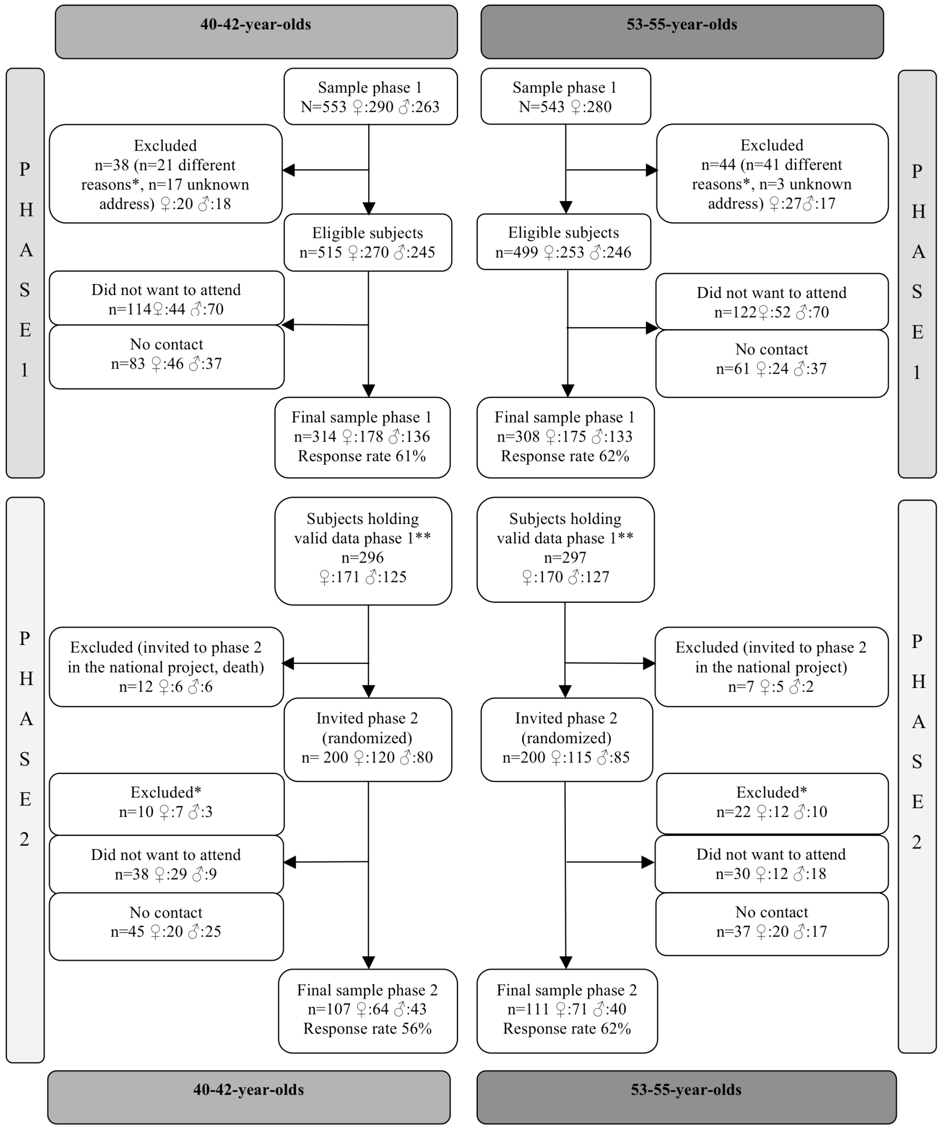


Figure 1. Overview of the study design and the subjects.

* Health situation, work situation, moved from the area

** Returned both valid accelerometer and valid questionnaire

Subjects with a low CVD risk (less than two health-risk items from the health status declaration) started at 4.8 km·h^{-1}, while subjects with a higher risk started at 3.8 km·h^{-1}. Twelve subjects in the 53-55-year-old-group used the higher-risk protocol. The Borg rating of perceived exertion (RPE) was recorded at the end of the test. If Borg RPE was ≥17 and/or RER (respiratory exchange ratio) was ≥1.10, the test was accepted as maximal. In the 40-42-year-old-group, 82 subjects had accepted recordings from the VO_{2max} test. Ten subjects conducted the test, but did not meet the criteria for a maximal test; 14 subjects did not have valid data due to technical problems, while one subject did not perform the test due to poor health status. In the 53-55-year-old-group 99 subjects had valid recordings from the VO_{2max} test. Nine subjects conducted the test, but did not meet the criteria for a maximal test, while three subjects did not test due to poor health status. VO_{2max}

was adjusted by a correction factor of 1.059 for analyzer differences in the national Kan1-study by an Oxycon Pro System (13).

Physical activity
PA was measured with the ActiGraph GT1M accelerometer (ActiGraph, LLC, Pensocola, Florida, USA). The accelerometer was initialized and downloaded by the software program ActiLife (ActiGraph, Pensacola, Florida, USA). The subjects were instructed to wear the monitor above the right hip during all waking hours for seven consecutive days, except during water activities and showering. A SAS-based software (SAS-Institute Inc, Cary, North Carolina, USA) called CSA Analyser (csa.svenssonspork.dk) was used for the data reduction.

The epoch length was set at 10 seconds and later collapsed into 60-second epochs for comparisons with other studies. All night activity (between 00:00 and 06:00) and all sequences of at least 60 minutes of consecutive zero counts, with an allowance for one to two minutes of activity, were excluded from each individual's recording. Subjects with at least ten hours of PA data for at least four days were included in further analyses. A total of 300 40-42-year-olds and 298 53-55-year-olds provided valid recordings. PA is presented as overall PA (mean counts per minute, cpm) in total and split by weekday and weekend, inactivity (min/day), light activity (min/day), moderate PA (MPA, min/day), vigorous PA (VPA, min/day) and the combined moderate to vigorous PA (MVPA, min/day). The following cut-off points were used: <100 cpm for inactivity, 100-2019 cpm for light activity, 2020-5998 cpm for MPA and ≥ 5999 cpm for VPA (23). Adherence to PA recommendations was examined by determining the proportion of the subjects that met the current Norwegian PA recommendations. The current recommendations are to accumulate at least 30 minutes of daily moderate PA in bouts of at least 10 minutes (7). For analysis, interruptions of one or two minutes of activity counts below threshold in the sustained MVPA bout were allowed. This allows for small breaks in activity (e.g. a water break) and avoids the entire bout being deleted if a small drop in intensity occurs in a sustained bout of activity.

Other measures
A questionnaire was used to record smoking habits (self-reported) in three categories: smokes, does not smoke, smoked earlier. Level of education was recorded as one of the following categories: less than high school, high school, university <4 years and university ≥4 years.

Statistics

All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 17.0 (SPSS Inc., Chicago, IL, USA). The distribution of each variable was tested for normality (Shaprio-Wilk). Results are presented as mean (SD) and mean difference [95% confidence interval], unless otherwise stated. General linear modelling was used to compare group means, and chi-square analyses were used to determine differences in distribution of education level and smoking habits between selected groups. A Pearson's correlation was used to investigate the relationship between PA and CRF. Significance level was set to $p \leq 0.05$.

RESULTS

Table 1 shows anthropometric characteristics, educational level and smoking habits by age-groups in total and by sex. In the 40-42-year-old-group significant differences between the sexes were observed in all variables except for smoking. Women had a significantly longer education compared to men ($p<0.001$). Furthermore, women had 1.5 kg/m^2 [95% CI: –2.4 to –0.6] lower BMI (body mass index) compared to men. Thirty-two percent of women and 47.2% of men were overweight (BMI 25.0-29.9) and 14.8% of women and 13.0% of men were obese (BMI ≥30.0). In the 53-55-year-old-group, significant differences between the sexes were observed in all variables except for education level and smoking. Women had 1.9 kg/m^2 [95% CI: –2.8 to –1.0] lower BMI compared to men. The percentage of overweight subjects was 35.0% for women and 50.4% for men, whereas 8.0% of women and 13.6% of men were obese. There was a significant interaction between age-group and sex for education level.

Table 2 shows levels of CVD risk factors by age-group, in total and by sex. Well-known gender differences in HDL-c and waist circumference were observed, and also lower blood pressure in women as compared to men at age below 50 years is a consistent observation in the literature (32). In addition, significant differences were observed between the two age-groups showing that the 40-42-year-old-group had 8.2 mmHg [95% CI: –11.9 to –4.5] lower SBP, 4.6 mmHg [95% CI: –7.0 to –2.1] lower DBP, 0.55 mmol/L [95% CI: –0.80 to –0.29] lower TC and 0.41 mmol/L [95% CI: –0.64 to –0.19] lower LDL-c compared to the 53-55-year-old-group.

In total, the two age-groups had 6.9 (0.8) valid days of accelerometer measurements. The mean accelerometer wear time among subjects with at least 4 days of valid measures was 14.9 (0.9) hours per day. Table 3 shows PA level by age group, in total and by sex. In the 40-42-year-old-group few significant differences between the sexes were observed. Nevertheless, women spent 6.0 min/day [95% CI: –11.7 to –0.3] less participating in MPA compared to men. In the 53-55-year-old-group, women were inactive for 36.0 min/day [95% CI: –55.2 to –16.8] less than men. In light activity, women spent 26.4 min/day [95% CI: 7.7 to 45.2] more compared to men. In addition, a significant difference was observed between the age-groups in VPA. The 40-42-year-old-group spent 2.7 min/day [95% CI: 1.6 to 3.9] more participating in VPA compared to the 53-55-year-old-group. Furthermore, for the test of interaction

Table 1. Mean (SD) or n (%) of anthropometric characteristics and educational level (phase 1) by age and sex.

	40-42-year-olds				53-55-year-olds					
	Men	Women	All	P for sex	Men	Women	All	P for sex	P for age-group	P for age-group*sex
Number (range)	123-136	169-178	292-314		124-132	163-175	288-307			
Age (yr)	40.8 (0.9)	40.7 (0.9)	40.8 (0.9)	0.705	53.7 (1.0)	53.5 (0.9)	53.6 (1.0)	0.215		0.504
Height (cm)	181.0 (7.3)	168.5 (5.6)	173.8 (8.9)	<0.001	180.0 (6.7)	166.9 (5.5)	172.5 (8.9)	<0.001	0.070	0.558
Weight (kg)	86.5 (13.1)	70.6 (11.9)	77.4 (14.7)	<0.001	86.8 (14.4)	69.6 (11.3)	77.1 (15.3)	<0.001	0.809	0.533
BMI (kg/m^2)	26.4 (3.6)	24.9 (4.3)	25.5 (4.1)	0.002	26.8 (3.8)	24.9 (3.6)	25.7 (3.8)	<0.001	0.614	0.485
Education level, n (%)				<0.001				0.919	0.001	0.002
University ≥4 yrs	23 (17.7)	66 (37.7)	89 (29.2)		31 (24.0)	41 (23.4)	72 (23.7)			
University <4 yrs	27 (20.8)	49 (28.0)	76 (24.9)		27 (20.9)	35 (20.0)	62 (20.4)			
High school	75 (57.7)	57 (32.6)	132 (43.3)		52 (40.3)	79 (45.1)	131 (43.1)			
Less than high school	5 (3.8)	3 (1.7)	8 (2.6)		19 (14.7)	20 (11.4)	39 (12.8)			
Smoking, n (%)				0.737				0.443	0.378	0.340
Smokers	23 (17.8)	29 (16.4)	52 (17.0)		23 (17.6)	33 (19.2)	56 (18.5)			
Have never smoked	76 (58.9)	107 (60.5)	183 (59.8)		77 (58.8)	92 (53.5)	169 (55.8)			
Smoked earlier	30 (23.3)	41 (23.2)	71 (23.2)		31 (23.7)	47 (27.3)	78 (25.7)			

BMI, body mass index

Table 2. Mean (SD) of cardiovascular disease risk factors (phase 2) by age and sex.

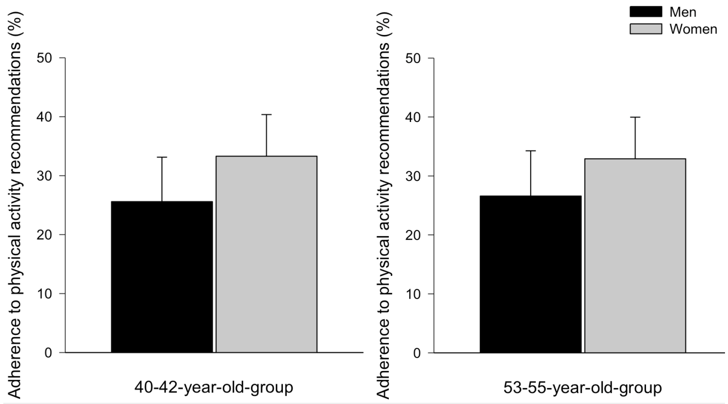
	40-42-year-olds				53-55-year-olds					
	Men	Women	All	P for sex	Men	Women	All	P for sex	P for age-group	P for age-group*sex
Number (range)	43-44	62-63	105-107		37-40	69-71	106-111			
SBP (mmHg)	135.7 (11.6)	124.7 (11.6)	129.2 (12.8)	<0.001	140.0 (13.9)	135.9 (15.6)	137.4 (15.0)	0.179	<0.001	0.063
DBP (mmHg)	80.8 (9.2)	76.7 (9.4)	78.3 (9.5)	0.029	84.5 (8.7)	82.0 (9.0)	82.9 (9.0)	0.151	<0.001	0.544
TC (mmol/L)	5.45 (0.98)	5.17 (0.90)	5.29 (0.94)	0.142	5.68 (0.99)	5.91 (0.93)	5.83 (0.95)	0.224	<0.001	0.058
HDL-c (mmol/L)	1.42 (0.38)	1.70 (0.43)	1.58 (0.43)	0.001	1.33 (0.38)	1.82 (0.52)	1.64 (0.53)	<0.001	0.386	0.093
TG (mmol/L)	1.67 (1.01)	1.01 (0.50)	1.28 (0.82)	<0.001	1.99 (1.46)	1.27 (0.57)	1.53 (1.04)	0.006	0.055	0.819
LDL-c (mmol/L)	3.29 (0.74)	3.01 (0.84)	3.12 (0.81)	0.090	3.58 (0.87)	3.52 (0.83)	3.54 (0.84)	0.729	<0.001	0.365
Glucose (mmol/l)	5.41 (1.18)	5.24 (1.07)	5.31 (1.11)	0.434	5.20 (0.88)	5.38 (1.00)	5.31 (0.96)	0.355	0.963	0.231
Waist (cm)	92.2 (12.5)	82.9 (12.0)	86.7 (13.0)	<0.001	94.5 (10.5)	83.5 (10.5)	87.5 (11.7)	<0.001	0.661	0.619

SBP, systolic blood pressure; DBP, diastolic blood pressure; TC, total cholesterol; HDL-c, high density lipoprotein; LDL-c, low density lipoprotein; TG, triglyceride

Table 3. Mean (SD) of physical activity (phase 1) by age and sex.

	40-42-year-olds				53-55-year-olds					
	Men	Women	All	P for sex	Men	Women	All	P for sex	P for age-group	P for age-group*sex
Number (range)	127-129	168-171	295-300		125-128	169-170	294-298			
Overall PA (cpm)	424.0 (161.3)	402.9 (142.4)	412.0 (150.9)	0.229	382.7 (144.3)	402.9 (143.9)	394.2 (144.2)	0.230	0.142	0.103
Inactivity (min/day)	516.5 (86.7)	513.0 (74.0)	514.5 (79.6)	0.700	546.2 (85.2)	510.2 (81.8)	525.7 (85.0)	<0.001	0.098	0.014
Light activity (min/day)	340.9 (77.5)	336.4 (75.2)	338.3 (76.1)	0.610	311.4 (80.1)	337.8 (82.3)	326.5 (82.3)	0.006	0.068	0.017
MPA (min/day)	41.2 (27.3)	35.2 (21.0)	37.8 (24.0)	0.039	38.9 (22.7)	41.5 (24.4)	40.4 (23.7)	0.362	0.188	0.040
VPA (min/day)	4.6 (8.2)	5.4 (9.5)	5.1 (9.0)	0.404	2.7 (5.7)	2.1 (4.3)	2.3 (4.9)	0.265	<0.001	0.176
MVPA (min/day)	45.8 (30.0)	40.7 (25.1)	42.9 (27.4)	0.119	41.7 (25.0)	43.5 (25.9)	42.7 (25.5)	0.534	0.947	0.141
PA weekdays (cpm)	415.2 (162.8)	390.6 (146.3)	401.2 (153.9)	0.170	365.7 (146.0)	396.0 (149.9)	383.0 (148.7)	0.082	0.142	0.032
PA weekends (cpm)	448.5 (249.1)	435.7 (205.6)	441.2 (225.1)	0.629	431.8 (211.8)	421.7 (198.9)	426.0 (204.2)	0.674	0.391	0.941

PA, physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity; cpm, counts per minute



Figur 2. Adherence (%) to physical activity recommendations (phase 1) by age and sex. For 40-42-year-olds n=300 (♂:171 ♀:129), for 53-55-years-olds n=298 (♂:170 ♀:128).

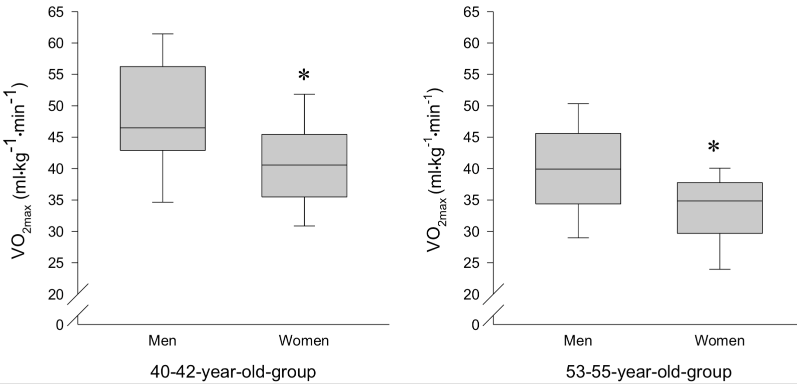


Figure 3. Box plot of cardiorespiratory fitness (ml·kg^{-1}·min^{-1}) by age and sex. For 40-42-year-olds n=82 (♂:35 ♀:47), for 53-55-years-olds n=99 (♂:37 ♀:62). The box covers the range between the lower and the upper quartiles; the whiskers cover the range between the 5th and the 95th percentiles, and the horizontal bar dividing the box indicates the mean.*p <0.001 between sexes in both age-groups and between age-groups.

between age-groups and sex, significant findings were made regarding inactivity (p=0.014), light activity (p=0.017), MPA (p=0.040) and PA during weekdays (p=0.032). Women had 35.6 cpm [95% CI: 16.1 to 55.0] and men had 48.9 cpm [95% CI: 23.3 to 75.0] higher overall PA levels during weekends than on weekdays.

Figure 2 shows adherence to the PA recommendation. In the 40-42-year-old-group 30.0% [95% CI: 24.8 to 35.2] met the recommendations, while 30.2% [95% CI: 25.0 to 35.4] met the recommendations in the 53-55-year-old-group. There were no significant differences between the sexes or age-groups.

Figure 3 displays CRF by age-group, in total and by sex. In the 40-42-year-old-group, women had 7.4 ml·kg^{-1}·min^{-1} [95% CI: –11.0 to –3.8] lower $VO_{2\ max}$ compared to men, whereas women in the 53-55-year-old-group had 7.3 ml·kg^{-1}·min^{-1} [95% CI: –10.4 to–4.1] lower $VO_{2\ max}$ compared to men. Furthermore, the 40-42-year-old-group had 8.2 ml·kg^{-1}·min^{-1} [95% CI: 5.6 to 10.7] higher $VO_{2\ max}$ compared to the 53-55-year-old-group.

There was a medium, positive correlation between overall PA level (cpm) and CRF (ml·kg^{-1}·min^{-1}) in both sexes. For men r=0.40 [95% CI: 0.18 to 0.58] and for women r=0.42 [95% CI: 0.25 to 0.56], with high overall PA level associated with high CRF.

DISCUSSION

Physical activity

The present study shows higher overall PA level and adherence to the PA recommendations compared to the national sample in Kan1 (13). Furthermore, when comparing our data to international studies such as the National Health and Nutrition Examination Survey

(NHANES) and the Attitude Behaviour and Change Study (ABC-study), the same conclusions can be drawn (25). However, it is difficult to compare these studies due to the difference in cut-off points for age-groups in all four studies, and slightly different methods of data reduction and definitions of PA recommendations in the NHANES and ABC-study compared to Kan1 and the present study. Adherence to PA recommendations in the present study is in contrast to previous studies which used self-reporting and found higher adherence to the recommendation (13,17). On the other hand, Haakstad and Bø (15) found markedly lower degrees of adherence to PA recommendations using self-report. Discrepancies between studies are most likely due to differences in the questions and the limitations of self-report as mentioned earlier. Although there is a higher adherence to the PA recommendations in Sogn og Fjordane compared to the national sample, from a public health perspective, 30% is not satisfactory taken into account the convincing evidence of health outcomes for those who meet the PA recommendations (9). This emphasizes the importance of implementing effective strategies to increase the daily PA level.

The higher overall PA level on weekends compared to weekdays found is consistent with the findings in Kan1 (13). However, the difference reported in Kan1 is minimal compared to the present study. The present study shows higher PA levels on both weekdays and weekends compared to Kan1, but the difference is more marked during weekends (p=0.013). This indicates that 40-42-year-olds and 53-55-year-olds in Sogn og Fjordane are especially active during weekends compared to the national sample. This might be due to easy access to outdoor-life, which is supported by the fact that 88% reported walking and hiking, a typical Norwegian weekend activity, as activities done on a regular basis (data not shown), compared to 79% in the national sample in Kan1 (13).

The present study shows no sex difference in overall PA. This is in line with Kan1 (13), but in contrast with NHANES and the ABC-study, where men were found to be more physically active than women (22, 23). However, sex differences in different intensities of PA were found in the present study, indicating that in the 40-42-year-old-group men spent more time in MPA than women, and that in the 53-55-year-old group men spent more time on inactivity and less time in light activity than women. These results are in agreement with those reported in the Kan1 study (13) and partly in line with the results of the NHANES and ABC-study (25). In contrast to Kan 1, results in the present study revealed age-group differences showing more time spent in VPA among 40-42-year-olds compared to the 53-55-year-olds.

Cardiorespiratory fitness

Few comparable studies investigating CRF in a representative population exist. Findings from the present study show higher CRF for both sexes and age-groups compared to the national sample in Kan1 (29). Furthermore, the same conclusion was reached when compared to a study by Haakstad and Bø (15), however, this study used an indirect measure of CRF. In both age-groups in the present study, men had higher CRF than women. This is in agreement with the existing literature, claiming a 15-30% lower VO_{2max} for women compared to men (33). As expected, the 40-42-year-old-group has higher CRF compared to the 53-55-year-old-group. This finding is consistent with the yearly age-related 1% decline in VO_{2max} for adults described in the literature (33), indirectly validating data representativeness.

As expected, positive correlations between PA and CRF in both sexes were found. These findings are supported by Løchen et al. (14), who found a correlation coefficient of 0.18 in men and 0.39 in women. The stronger correlation in the present study might be due to more accurate measurements, as PA is measured objectively and CRF is measured directly. Løchen et al. (14) explained the sex difference by the fact that the fitness test truly was maximal in most women while the load was too low for many men. The fact that direct measurement of CRF was used in the present study might explain the small difference in correlation with sex.

Cardiovascular disease risk factors

BMI is marginally lower compared to the national sample in Kan1 (13) and marginally higher for the 40-42-year-old-group compared to previous collected BMI data from the population in Sogn og Fjordane (34). For women, BMI is lower compared to data from the HUNT study (35) and the Tromsø study (36). For men, the BMI results are in line with the HUNT data in both age-groups and slightly higher compared to the Tromsø data for the 53-55-year-olds. BMI is not a direct measurement of body fatness and does not distinguish between fat and muscle mass, but is a surrogate for adiposity and an applicable measure to use in population based studies (37).

For the 40-42-year-olds, SBP is marginally lower, especially for women, compared to results from the National Health Screening Service in Sogn og Fjordane in the mid-nineties, while DBP is higher in the present study in both sexes (38). When comparing blood pressure with previous studies one should bear in mind that different measuring devices for blood pressure have been used. The present study used an automatic Omron HEM-907 BP monitor, while the National Health Screening Services used an automatic Dinamap (39).

In the present study, both sexes in the 40-42-year-old-group have lower prevalence of daily smokers, lower TC and higher HDL-c compared to the National Health Screening Services in Sogn og Fjordane in 1996 (38). These findings are consistent with the findings of Jenum et al. (40), which show a decrease in TC and smoking habits through thirty years. There is no difference in the prevalence of daily smokers in the present study compared to Kan1. However, the percentages of 'have never smoked' is higher and 'smoked earlier' is lower in the present study compared to Kan1 (13).

Sogn og Fjordane County has Norway's longest living population (26). The county has a reputation of being the most healthy county in Norway (27) and is among the counties with lowest CVD mortality (28). Furthermore, the observation of the population of Sogn og Fjordane being more PA and having higher CRF underscores this statement.

Strength and limitations

Objectively measured PA, high compliance with the protocol and directly measured CRF strengthen the findings reported in this study. Also, the high response rate from a narrow age sample is a strength. However, these findings should be interpreted in light of the following limitations. First, this cross-sectional study does not allow explanations of causality. Second, the accelerometer is not able to accurately assess non-ambulatory activity, such as cycling or swimming (41). For people who cycle or do upper-body exercises on a regular basis, PA is underestimated. However, Kan1 shows that people mostly do ambulatory activities (13). Third, the uniaxial Actigraph used in the present study does not register high-speed activity satisfactory, such as running over 10 km/h. However, the large majority of people carry out little regular running at this speed (41). Fourth, the PA intensity thresholds vary widely between studies (41). This hampers study comparability and underlines the uncertainty of the cut-off points. The present study uses the same cut-off points as were used in Kan1 and NHANES (13,23). Fifth, non-fasting blood samples were taken in phase 2, which gives higher values of glucose and triglycerides than if they had been taken in the fasting state. However, this was done to facilitate comparison with previous studies using non-fasting blood samples (39). Sixth, although the response rate was high compared to recent similar studies, almost 40% chose not to participate, and we cannot rule out the possibility of a selection bias. Because the aim of the study was to assess levels of PA and CRF, it is likely that the most physically active participated. If this is correct, there are reasons to believe that several of our findings may be overestimated.

CONCLUSIONS

The aim of this cross-sectional study was to describe levels of objectively measured PA, directly measured CRF and CVD risk factors in an adult population in the county of Sogn og Fjordane. These results support the hypotheses that the population of Sogn og Fjordane County are more physically active and have higher CRF compared to the rest of the Norwegian population. However, from a public health perspective, taken into account the convincing evidence of health outcomes for those who meet the PA recommendations, 30% adherence to the PA recommendations is not satisfactory. Therefore, it is necessary to implement effective strategies aiming to increase daily PA level.

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REFERENCES

1. Blair SN, Cheng Y, Holder JS. Is physical activity or physical fitness more important in defining health benefits? *Med Sci Sports Exerc* 2001; **33** (6 Suppl): 379-99.
2. Aadahl M, Kjær M, Jørgensen T. Associations between overall physical activity level and cardiovascular risk factors in an adult population. *Eur J Epidemiol* 2007; **22** (6): 369-78.
3. Ekblom-Bak E, Hellenius ML, Ekblom O, et al. Independent associations of physical activity and cardiovascular fitness with cardiovascular risk in adults. *Eur J Cardiovasc Prev Rehabil* 2010; **17** (2): 175-80.
4. World Health Organization. Global health risks. Mortality and burden of disease attributable to selected major risks. 2009. Genova. World Health Organization.
5. Blair SN, Kampert JB, Kohl HW, III, et al. Influences of cardiorespiratory fitness and other precursors on cardiovascular disease and all-cause mortality in men and women. *JAMA* 1996; **276** (3): 205-10.
6. Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health. Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation* 2007; **116** (9): 1081-93.
7. Becker W, Alexander J, Andersen S, et al. [Nordic nutrition recommendations]. *Ugeskr Laeger* 2006; **168** (1): 76-7.
8. Sosial- og Helsedirektoratet. Fysisk aktivitet og helse. Anbefalinger [Physical Activity and Health. Recommendations]. Rapport 2. 2000. Oslo. Sosial- og helsedirektoratet.

9. Leitzmann MF, Park Y, Blair A, et al. Physical activity recommendations and decreased risk of mortality. *Arch Intern Med* 2007; **167** (22): 2453-60.
10. Warren JM, Ekelund U, Besson H, et al. Assessment of physical activity – a review of methodologies with reference to epidemiological research: a report of the exercise physiology section of the European Association of Cardiovascular Prevention and Rehabilitation. *Eur J Cardiovasc Prev Rehabil* 2010; **17** (2): 127-39.
11. Aires N, Selmer R, Thelle D. The validity of self-reported leisure time physical activity, and its relationship to serum cholesterol, blood pressure and body mass index. A population based study of 332,182 men and women aged 40-42 years. *Eur J Epidemiol* 2003; **18** (6): 479-85.
12. Sallis JF, Saelens BE. Assessment of physical activity by self-report: status, limitations, and future directions. *Res Q Exerc Sport* 2000; **71** (2 Suppl): 1-14.
13. Helsedirektoratet. Fysisk aktivitet blant voksne og eldre i Norge – Resultater fra en kartlegging i 2008 og 2009 [Physical Activity among Adults and Elderly in Norway]. IS-1754. 2009. Oslo. Helsedirektoratet.
14. Løchen ML, Rasmussen K. The Tromsø study: physical fitness, self reported physical activity, and their relationship to other coronary risk factors. *J Epidemiol Community Health* 1992; **46** (2): 103-7.
15. Haakstad LAH, Bø K. Fitness and physical activity in Norwegian adults. *Adv Physiother* 2007; **9**: 89-96.
16. Graff-Iversen S, Skurtveit S, Nybø A, et al. [Trends when it comes to occupational physical activity among Norwegians aged 40-42 years during the period 1974-94]. *Tidsskr Nor Laegeforen* 2001; **121** (22): 2584-8.
17. Anderssen SA, Andersen LB. Fysisk aktivitetsnivå i Norge 2003: Data basert på spørreskjemaet "International Physical Activity Questionnaire" [Level of Physical Activity in Norway 2003]. IS-1254. 2004. Oslo. Sosial- og Helsedirektoratet.
18. Søgaard AJ, Bø K, Klungland M, et al. En oversikt over norske studier – hvor mye beveger vi oss i fritiden? [A review of Norwegian studies – how much do we exercise during our leisure time?]. *Tidsskr Nor Lægeforen* 2000; **120** (28): 3439-46.
19. Helsedirektoratet. Omnibus. 2008.
20. Shephard RJ. Limits to the measurement of habitual physical activity by questionnaires. *Br J Sports Med* 2003; **37** (3): 197-206.
21. Freedson PS, Miller K. Objective monitoring of physical activity using motion sensors and heart rate. *Res Q Exerc Sport* 2000; **71** (2 Suppl): 21-9.
22. Hagströmer M, Oja P, Sjöström M. Physical activity and inactivity in an adult population assessed by accelerometry. *Med Sci Sports Exerc* 2007; **39** (9): 1502-8.
23. Troiano RP, Berrigan D, Dodd KW, et al. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc* 2008; **40** (1): 181-8.
24. Bauman A, Bull F, Chey T, et al. The International Prevalence Study on Physical Activity: results from 20 countries. *Int J Behav Nutr Phys Act* 2009; **6** (1): 21.
25. Hagströmer M, Troiano RP, Sjöström M, et al. Levels and patterns of objectively assessed physical activity – a comparison between Sweden and the United States. *Am J Epidemiol* 2010; **171** (10): 1055-64.
26. Norgeshelsa. Forventet levealder [Life expentancy]. http://www.norgeshelsa.no/norgeshelsa. Downloaded: 16-9-2010.
27. Bjartveit K, Wøien G. Cardiovascular disease risk factors in Norway – Results from surveys in 18 counties. 1997. Oslo. National Health Screening Service.
28. Norgeshelsa. Dødsårsak [Cause of death]. http://norgeshelsa.no/norgeshelsa. Downloaded: 16-9-2010.
29. Helsedirektoratet. Fysisk form blant voksne og eldre i Norge – Resultater fra en kartlegging i 2009-2010 [Physical Fitness among Adults and Elderly in Norway]. IS-1816. 2010. Oslo. Helsedirektoratet.
30. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clin Chem* 1972; **18** (6): 499-502.
31. Balke B. [Optimum physical working capacity, its measurement and change as a result of the working fatigue.]. *Arbeitsphysiologie* 1954; **15** (4): 311-23.
32. Holme I, Waaler HT. Five-year mortality in the city of Bergen, Norway, according to age, sex and blood pressure. *Acta Med Scand* 1976; **200** (3): 229-39.
33. McArdle WD, Katch FI, Katch VL. Exercise Physiology. Baltimore: Lippincott Williams & Wilkins, 2001.
34. Tverdal A. [Height, weight and body mass index of men and women aged 40-42 years]. *Tidsskr Nor Laegeforen* 1996; **116** (18): 2152-6.
35. Drøyvold WB, Nilsen TI, Krüger Ø, et al. Change in height, weight and body mass index: Longitudinal data from the HUNT Study in Norway. *Int J Obes* 2006; **30** (6): 935-9.
36. Wilsgaard T, Arnesen E. Body mass index and coronary heart disease risk score: the Tromsø study, 1979 to 2001. *Ann Epidemiol* 2007; **17** (2): 100-5.
37. World Health Organization. Physical Status: The use and interpretation of anthropometry. Technical Report Series No. 854. 1995. Geneva, Switzerland.

38. Wøien G, Øyen O, Graff-Iversen S. 22 years of cardiovascular surveys in Norwegian counties. Is the development in risk factors satisfactory? *Nor J Epidemiol* 1997; **7** (2): 255-66.
39. Bjartveit K, Stensvold I, Lund-Larsen PG, et al. [Cardiovascular screenings in Norwegian counties. Background and implementation. Status of risk pattern during the period 1986-90 among persons aged 40-42 years in 14 counties]. *Tidsskr Nor Laegeforen* 1991; **111** (17): 2063-72.
40. Jenum AK, Graff-Iversen S, Selmer R, et al. [Risk factors for cardiovascular disease and diabetes through three decades]. *Tidsskr Nor Laegeforen* 2007; **127** (19): 2532-6.
41. Corder K, Brage S, Ekelund U. Accelerometers and pedometers: methodology and clinical application. *Curr Opin Clin Nutr Metab Care* 2007; **10** (5): 597-603.

Paper II

BMC Public Health

RESEARCH ARTICLE Open Access

Physical activity and cardiovascular risk factors in a 40- to 42-year-old rural Norwegian population from 1975–2010: repeated cross-sectional surveys

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Abstract

Background: Geographical differences in cardiovascular diseases (CVD) have been observed among Norwegian counties. Better long-term health status and higher physical activity (PA) levels have been documented in the county of Sogn & Fjordane compared with other counties. However, recent trends in CVD risk factors have not been documented. The aim of this study was to investigate the secular trends in leisure time physical activity (LTPA) and other CVD risk factors over a 35-year period in a rural population of 40- to 42-year-olds in western Norway and to compare these trends with national trends.

Methods: Data from eight cross-sectional studies from 1975–2010 (n = 375,682) were obtained from questionnaires and physical examinations and were analyzed using mixed model regression analyses.

Results: Decreasing trends were observed for sedentary behavior (for women), moderate PA, smoking, systolic blood pressure (SBP), diastolic blood pressure (DBP), high-density lipoprotein (HDL-c) and total cholesterol (TC), whereas increasing trends were observed for body mass index (BMI), triglycerides (TG), light PA, vigorous PA and sedentary behavior for men. Compared to the national trends, the trends in the 40-42-year-olds from Sogn & Fjordane were more beneficial in terms of TG, HDL-c and BMI but less beneficial in terms of SBP and DBP.

Conclusions: Over a 35-year-period, this study indicates that the LTPA level has been relatively stable in the county of Sogn & Fjordane. Upward trends were observed in light and vigorous PA, whereas a downward trend was observed in moderate PA. For sedentary behavior, an upward trend was observed in men, whereas a downward trend was observed in women. For smoking, BP and cholesterol decreasing trends were found, but increasing trends were observed in BMI and TG. Compared with the national data, the trends in Sogn & Fjordane were more beneficial for TG, HDL-c and BMI but less beneficial for BP.

Keywords: Physical activity, Cardiovascular disease, Risk factors, Trends, Geographic variation

Background

In the 1970s, Norway had a high cardiovascular disease (CVD) mortality rate compared to the present rate, even in an international context [1]. Considerable variation in the CVD mortality rates among Norwegian counties have been observed [1], and the county of Sogn & Fjordane had the lowest CVD mortality rate in Norway from 1964–1975 [1].

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As of 2013, Sogn & Fjordane has a population of approximately 110,000 inhabitants, and people mainly live in small urban areas or are scattered over a wide area [2]. Furthermore, the divorce rate is lower [3], the education level is higher, and the unemployment rate is lower compared with the rest of Norway [4]. The life expectancy is currently 78.3 years for men and 83.6 years for women, compared with the national averages of 77.2 years for men and 82.2 years for women [4].

Beginning in 1975, the National Health Screening Service (NHSS) implemented a screening program for CVD risk. The results from this program have shown that

Sogn & Fjordane county had one of the lowest levels of infarct risk in Norway until 1995 [5].

Inconsistent results have been found in studies investigating secular trends in leisure time physical activity (LTPA) [6-9]. A substantial decrease in the prevalence of smoking has been found in both sexes [6,10]. An increase in body mass index (BMI) has been observed in all segments of the population during recent decades, both in Norway [6,10-12] and in most other Western countries [13]. Furthermore, blood pressure (BP) and total cholesterol (TC) levels have decreased in Norway [10] and in the majority of other Western countries [14,15].

Understanding the geographic variation in CVD risk factors is important because it may provide useful information about implementing interventions to improve cardiovascular health at the community level. Because of the positive long-term health status of the population of Sogn & Fjordane and the shift in traditional CVD risk factors, it is interesting to investigate whether this region has maintained a better risk factor status than the rest of Norway. Thus, the aim of this study was to investigate the secular trends in LTPA and other CVD risk factors over a 35-year period in a 40- to 42-year-old healthy rural population in western Norway and to compare these trends with national trends over the same time period.

Methods

Population

Data from Sogn & Fjordane were collected in seven cross-sectional studies by the NHSS (1975–1999) and The Physical Activity among Adults and Older People Study (2010), a multicenter study conducted by the Norwegian School of Sport Sciences. All eight studies invited all 40- to 42-year-olds to participate (for the last cohort in three municipalities, whereas a randomly selected sample of 40-42-year-olds were invited throughout Norway). The dataset (n = 21,372) includes data from all 26 municipalities in Sogn & Fjordane (Table 1). The response rate varied from 92% in 1975 to 60% in 2010. To compare Sogn & Fjordane with the rest of the country, data from the other 18 counties in Norway (n = 354,310) were used. The participation rate ranged from 32% to 94%, with a decreasing trend from 1975 to the present [5,16]. The population details have been described elsewhere [5,17].

Table 1 Overview of the study population in Sogn & Fjordane, n, participation rate (%)

Cohort, year	Invited	Attended	Participation rate (%)
Cohort I, 1975	2781	2564	92
Cohort II, 1980	2940	2571	87
Cohort III, 1985	3796	3060	81
Cohort IV, 1990	3904	3228	83
Cohort V, 1993	4338	3261	75
Cohort VI, 1996	4402	3264	74
Cohort VII, 1999	4433	3091	70
Cohort VIII, 2010	553	333	60
In total	27147	21372	79

In the cohorts from 1975–1999, the data were gathered using questionnaires and physical examinations. The participants were invited to a health screening, and a survey questionnaire collected self-reported LTPA, smoking and education level. The examinations included weight, height and BP measurements and blood sample collections. The surveys were administered by the NHSS mobile teams [5].

In the cohort in 2010, the data were collected by postal mail for all participants, whereas a physical examination was conducted on random selected 1/3 of the participants. A questionnaire covered self-reported LTPA, smoking, weight, height and educational level. Two experienced nurses measured weight, height and BP and collected blood samples [17].

The participants provided written informed consent [17]. The Norwegian Institute of Public Health has given their approval to use the data from the National Health Screening Service. The study was approved by the Regional Committee for Medical Research Ethics, the Norwegian Social Science Data Services AS and the Norwegian Tax Department.

Measures

Physical activity

In all cohorts, except in 1996, LTPA was self-reported using a questionnaire developed in Gothenburg [18]: *Please note your exercise and physical exertion in leisure time. If the activity varies considerably, e.g. between summer and winter, then give an average. The question applies to the past year. Tick "YES" beside the description that fits best*: (*1*) *Reading, watching TV or other sedentary activity*?; (*2*) *Walking, cycling, or other forms of exercise at least 4 hours per week*? (*Including walking or cycling to place of work, Sunday-walking, etc.*); (*3*) *Participation in recreational sports, heavy gardening, etc.*? (*Note*: *duration of activity at least 4 hours a week*); (*4*) *Participation in hard exercise or sports competitions, regularly several times a week*? [18-20]. LTPA was then classified in four categories: 1) sedentary behavior, 2) light physical activity (PA), 3) moderate PA and 4) vigorous PA.

Cardiovascular disease risk factors

In the cohorts from 1975–1999, weight and height were measured to the nearest 0.5 kg and 1 cm [21,22]. In the 2010 cohort, weight and height were both measured to the nearest 0.1 kg and 0.5 cm (n = 115) and self-reported (n = 333) [17]. Body composition was expressed as BMI (kg/m^2).

Systolic BP (SBP) and diastolic BP (DBP) were measured manually using the mercury method (Erkameter, ERKA, Kallmeyer Medizintechnik GmbH & Co.KG, Bad Tölz, Germany) in 1975 and 1980. Measurements were taken two times with a one-minute interval between the measurements [23]. In the 1985–1999 cohorts, the measurements were taken automatically using a Dinamap BP monitor (Critikon Cooperation, Tampa, Florida, USA) [24]. In the 2010 cohort, BP was measured automatically using an Omron HEM-907 BP monitor (Omron Healthcare, Inc., Vernon Hills, IL, US) in Sogn & Fjordane [17] and a manual sphygmomanometer (Big Ben, Reister, Junginen, Germany) in the other counties [25]. From 1985 onward, three repeated measurements were taken at one-minute intervals for all BP measurements [17,24]. The mean of the two last measurements was used in the statistical analyses. The validations of the Erkameter and the Dinamap have been described elsewhere [23]. Tests of agreement between the Omron and; Dinamap and Big Ben respectively showed small differences.

Non-fasting intravenous blood samples were taken from the antecubital vein. The samples were centrifuged immediately and sent to the Department of Medical Biochemistry at Oslo University Hospital, Ullevaal (Norway), where they were analyzed for TC and triglycerides (TG) (all cohorts) and high-density lipoprotein (HDL-c) (in 1980–2010) [5,17]. In 2010, blood samples were only taken in the county of Sogn & Fjordane [17]. Smoking was self-reported in all cohorts. To estimate the total 10-year risk of CVD mortality, the NORRISK model was used. The NORRISK model is based on Norwegian mortality data and risk profiles and contains of the following five risk factors: sex, age, TC, SBP and smoking [26]. Education data were dichotomously scored as 1) high school or less or 2) college or university.

Statistics

The descriptive results are presented as means and 95% confidence intervals (CI) (continuous data) or proportions (%) (categorical data). To investigate trends over time in the county of Sogn & Fjordane, we used two-level linear (continuous data) and logistic (categorical data) mixed model regression analyses with random intercepts for municipalities (n = 26) and with time (actual year) as the fixed variable. Because a non-linear trend was found for smoking, a categorical time variable (seven time-points) was used. The effect of sex was tested by including the main effect and the interaction effect (sex*time) in the models. Because only three municipalities were represented in 2010, mixed models were employed to detect any differences in the trends between the three municipalities and the rest of the county from 1975–1999. Due to the substantial differences in the population size, a trend analysis was performed from 1975–1999, and the developments from 1999–2010 were described by analyzing the levels of risk factors. To compare the trends in the county of Sogn & Fjordane with those in the rest of Norway, we applied two-level mixed model regression analyses including random intercepts for the counties (n = 19) (because a municipality variable was unavailable in the rest of Norway) and fixed effects for the county of Sogn & Fjordane vs. the rest of Norway. Because the non-fasting TG data were skewed, log-transformed data were used in the analysis, and the LnTG was adjusted for the amount of time since the last meal, with three hours as the reference. Bland-Altman plots and intra-class correlation coefficients were used to investigate the agreement between measured and self-reported weight and height in 2010 and to investigate the agreement between the two automatic BP instruments (Dinamap and Omron) and the two BP instruments used in 2010 (Omron and Big Ben). The BMI values were adjusted for the measurement method and for smoking, but the crude results are presented because the differences were minor. The BP data were corrected for the BP measurement instrument with the Omron as the reference. The results are reported as changes (continuous variables) and odds ratios (OR, categorical variables) with 95% CIs and observed significance levels. The analyses were performed using STATA version 12 (StataCorp, College Station, TX, USA).

Results

Trends in Sogn & Fjordane

Table 2 presents the proportion of men and women who reported sedentary, light, moderate and vigorous PA in each cohort. In total, LTPA has been relatively stable over 35 years. For sedentary behavior, no significant trend was found from 1975–1999 for men and women combined (Table 3). However split by sex, a significant decreasing trend was observed for women (OR 0.992, 95% CI: 0.985,0.999), whereas an increasing trend was found for men (OR 1.012, 95% CI: 1.004,1.020). For both sexes, a decrease was observed from 1999–2010 (Figure 1a). A significant increasing trend was observed in light (for women only) and vigorous PA (for both sexes) from 1975–1999 (Table 3). From 1999–2010, there was a decrease in light PA and a further increase in vigorous PA (Figure 1b). A significant decreasing trend in moderate PA was observed for both sexes from 1975–1999 (Table 3), however, this trend increased to 2010 (Figure 1b). A significant decreasing trend in smoking was observed among men from 1975–1999, whereas a significant increasing trend was observed among women (Figure 2a). Thereafter, there was a decrease in smoking for both sexes. Over 35 years smoking decreased by 31.7% for men and 15.8% for women. The mean BMI (Figure 2b) increased between 1975–1999 for both sexes, but the trend leveled off thereafter. Over 35 years BMI has increased by 1.8 kg/m^2 for men and 0.7 kg/m^2 for women. 55.6% men and 44.4% women were overweight or obese in 2010 compared to

Table 2 Descriptive data on physical activity level and other risk factors in Sogn & Fjordane, stratified by sex, %

		1975	1980	1985	1990	1993	1996	1999	2010
Sedentary behavior	**Men**	16.7	12.2	13.6	15.6	12.3	---	21.2	15.6
	Women	22.1	10.2	13.7	15.5	12.0	---	16.6	9.7
Light PA	**Men**	53.6	45.2	53.0	51.6	52.0	---	52.5	48.4
	Women	67.2	70.5	71.3	72.6	75.1	---	70.4	68.3
Moderate PA	**Men**	28.2	40.4	31.0	30.0	32.8	---	23.2	27.7
	Women	10.6	19.2	14.6	11.2	12.4	---	11.7	18.6
High PA	**Men**	1.4	2.2	2.4	2.8	2.8	---	3.1	7.4
	Women	0	0.1	0.5	0.7	0.5	---	1.3	3.4
Smokers	**Men**	49.1	40.6	40.2	40.2	36.9	37.6	31.9	17.4
	Women	31.7	31.2	32.3	38.0	36.5	32.8	35.9	15.9
BMI ≥25 kg/m^2	**Men**	40.9	46.5	51.0	51.3	53.5	58.7	64.7	55.6
	Women	34.5	30.0	33.0	32.5	35.8	34.8	43.3	44.4
SBP >140 mmHg	**Men**	26.8	28.6	22.8	22.8	19.8	24.7	16.7	38.3
	Women	17.1	16.0	13.0	9.7	10.3	10.1	5.6	16.7
TC >5.0 mmol/L	**Men**	86.5	79.9	85.8	76.2	73.0	74.3	76.1	63.6
	Women	85.2	75.3	79.4	65.3	62.5	58.8	61.5	48.4
HDL-c ≤0.90 mmol/L (men), ≤1.00 mmol/L (women)	**Men**	---	10.4	6.8	---	---	9.6	15.6	9.1
	Women	---	4.2	2.1	---	---	5.2	10.0	6.5
TG > 1.7 mmol/L	**Men**	46.6	43.1	48.8	47.9	49.6	47.4	50.2	38.6
	Women	15.7	12.4	16.8	19.1	18.5	16.9	20.6	9.7

PA, physical activity; *BMI*, body mass index; *SBP*, systolic blood pressure; *TC*, total cholesterol; *HDL*-c, high density lipoprotein; *TG*, triglyceride.

40.9% and 34.5% in 1975. With regard to SBP and DBP, a significant decreasing trend was observed for both sexes from 1975–1999 (Figure 2c). From 1999–2010, an increase was observed for both sexes (corresponding to 12.1 mmHg for SBP and 5.1 mmHg for DBP). Table 2 presents the proportion of men and women who were smokers, were overweight or obese or had hypertension in each cohort.

Significant decreasing trends in TC and HDL-c were observed for both men and women between 1975 and 1999 (Figure 2d). From 1999–2010, an additional decrease in TC was observed, whereas an increase in HDL-c was observed for both sexes. Over 35 years TC decreased by 0.79 mmol/L for men and 0.92 mmol/L for women, whereas HDL-c increased by 0.16 mmol/L for both sexes from 1980–2010. A significant increasing trend in TG was observed between 1975 and 1999, but TG decreased for both sexes after 1999. College or university education in Sogn & Fjordane increased from 26% in 1996 to 37% in 2010. Table 2 presents the proportion of men and women who had TC, HDL-c and TG levels above clinical cut-offs in each cohort.

Table 3 Trend in levels of physical activity in Sogn & Fjordane from 1975-1999

	Change	95% CI	p-value
Gothenburg instrument LTPA			
Sedentary behavior	1.002	(0.997, 1.007)	0.481
Light PA	1.007	(1.003, 1.011)	≤0.001
Moderate PA	0.985	(0.981, 0.990)	≤0.001
High PA	1.037	(1.021, 1.054)	≤0.001

95% *CI*, 95% confidence interval; *LTPA*, leisure time physical activity; *PA*, physical activity. All data are yearly average ORs.

Trends in sogn & fjordane compared with national trends

Sogn & Fjordane had more beneficial trends for TG, HDL-c and BMI but less beneficial trends for SBP and DBP compared with the rest of Norway (Table 4). No difference in trend was found for PA between Sogn & Fjordane and the rest of Norway. . The distribution of the total 10-year risk of CVD mortality in Sogn & Fjordane (1975, 1999 and 2010) and in the rest of Norway (1975 and 1999), as estimated by the NORRISK score, is presented in Figure 3a-b. The decrease in the total CVD risk was marginally but significantly greater in the rest of Norway than in Sogn & Fjordane from 1975–1999 (Table 4). This difference corresponds to a 0.085% decrease in the total risk of CVD mortality nationally compared with a 0.069% decrease in Sogn & Fjordane over 10 years.

Discussion

Overall, the LTPA level in Sogn & Fjordane has been relatively stable over a 35-year period. A beneficial trend was observed in terms of sedentary behavior (for women), light

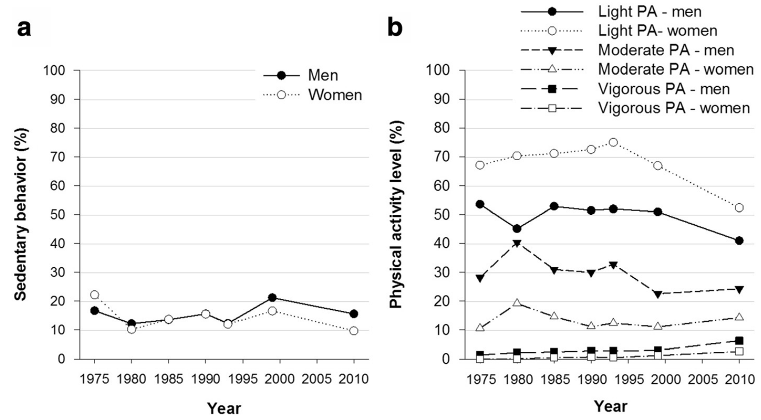

Figure 1 Trends in leisure time physical activity in Sogn & Fjordane 1975–2010. (a) Sedentary behavior and **(b)** physical activity, stratified by sex, proportion (%).

and vigorous PA, but commitment to moderate PA decreased and sedentary behavior increased (among men). With respect to smoking, BP and cholesterol decreasing trends were found, but increasing trends were observed in BMI and TG. Although some of the changes seems minor, changes are large in the population as a whole [27]. Compared with the national data, the trends in Sogn & Fjordane were more beneficial for TG, HDL-c and BMI but less beneficial for BP.

Trend data on PA are scarce [9], and inconsistent results have been found for LTPA in previous studies [6-9]. The observed LTPA trend may indicate a shift

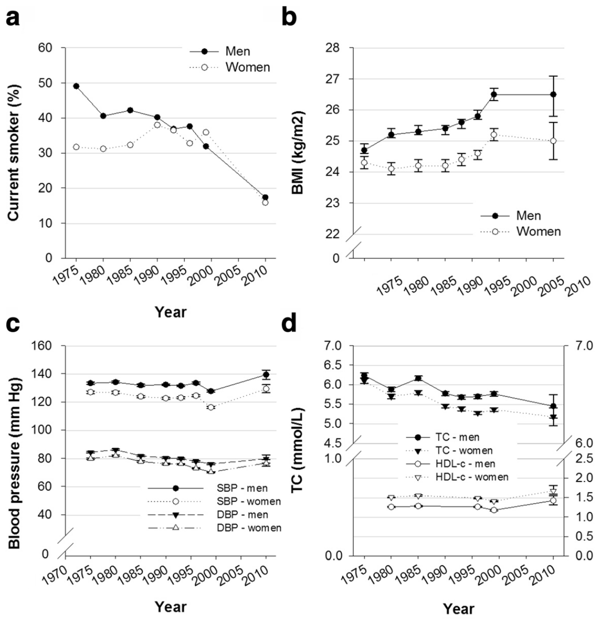

Figure 2 Trends in other risk factors in Sogn & Fjordane 1975–2010. (a) Smokers, **(b)** BMI, **(c)** blood pressure and **(d)** TC and HDL-c, stratified by sex, proportion (%) or mean (95% CI). Body mass index; BMI, systolic blood pressure; SBP, diastolic blood pressure; DBP, total cholesterol; TC and high density lipoprotein; HDL-c.

Table 4 Trend in risk factors in Sogn & Fjordane versus the rest of Norway from 1975-1999

	Trend Sogn & Fjordane			Trend rest of Norway			Difference in trend		
	Change	95% CI	p-value	Change	95% CI	p-value		95% CI	p-value
BMI (kg/m^2)	0.04	(0.04, 0.05)	≤0.001	0.08	(0.08, 0.08)	≤0.001	−0.04	(−0.03, −0.04)	≤0.001
SBP (mmHg)*	−0.26	(−0.29, −0.24)	≤0.001	−0.32	(−0.34, −0.31)	≤0.001	0.06	(0.09, 0.04)	≤0.001
DBP (mmHg)*	−0.41	(−0.43, −0.40)	≤0.001	−0.45	(−0.46, −0.45)	≤0.001	0.04	(0.06, 0.02)	≤0.001
HDL-c (mmol/L)	−0.003	(−0.004, −0.002)	≤0.001	−0.004	(−0.005, −0.004)	≤0.001	0.001	(0.002, 0.000)	0.045
TG (mmol/L)**	0.002	(0.001, 0.003)	0.002	0.004	(0.004, 0.005)	≤0.001	−0.003	(−0.002, −0.004)	≤0.001

95% *CI*, 95% confidence interval; *BMI*, body mass index; *SBP*, systolic blood pressure; *DBP*, diastolic blood pressure; *HDL*-c, high density lipoprotein; *TG*, triglyceride. All data are yearly average changes. **SBP* and *DBP* corrected for *BP* device with Omron as reference instrument, **TG adjusted for time since last meal with three hours as a reference.

from recreational walking toward specific training activities. Our study partly corroborate previous observations by Anderssen et al. who also found a downward trend for sedentary behavior (for women) and moderate PA (for men) and an upward trend for sedentary behavior (for men) and vigorous PA [6], Borodulin et al. [7] found an increasing trend in LTPA during the same period. Both these studies used the same PA questionnaire as in our study. The population in Sogn & Fjordane have reported lower levels of sedentary behavior and higher levels of physical activity compared to the rest of Norway for decades [5,17,28]. However, no differences in trend between the areas were observed. The increasing trend in sedentary behavior for men and the overall decreasing trend in moderate PA in Sogn & Fjordane might signal a transition toward less physically demanding work in addition to a motorized transportation pattern. The observed decrease in smoking confirms previous studies [6,10], and the pattern in Sogn & Fjordane over the last 35 years is similar to that in the rest of Norway.

The steady increase in BMI for men and the slightly U-shaped trend for women confirm the BMI trends identified in other national studies [5,6,10,11]. A substantial acceleration in the BMI increase was observed in the beginning of the 1990s for both sexes, and may be associated with the acceleration of the digital revolution happening at the same time. The decrease in smoking prevalence could also partly explain the BMI increase. Anderssen et al. [6] found that the increase in BMI was significantly larger in sedentary individuals compared with those who were more physically active. The development is explained as most likely caused by a changing environment that promotes calorie intake and counteracts energy expenditure [6]. Recent studies have indicated a possible slowing of the obesity epidemic [12,29]. Our study indicates that BMI values have plateaued during the last decade. Midthjell et al. [12] did not find a plateau in BMI in another Norwegian population, but they did observe a plateau in the proportion of the population that was overweight. The leveling off observed in BMI, might be related to the observed decrease in sedentary behavior and increace in moderate and vigorous PA from 1999–2010. The decreasing trend found in SBP and DBP in both Sogn & Fjordane and the rest of Norway is supported by national [10] and international [14] studies. The less beneficial trend in BP in Sogn & Fjordane compared with the rest of Norway

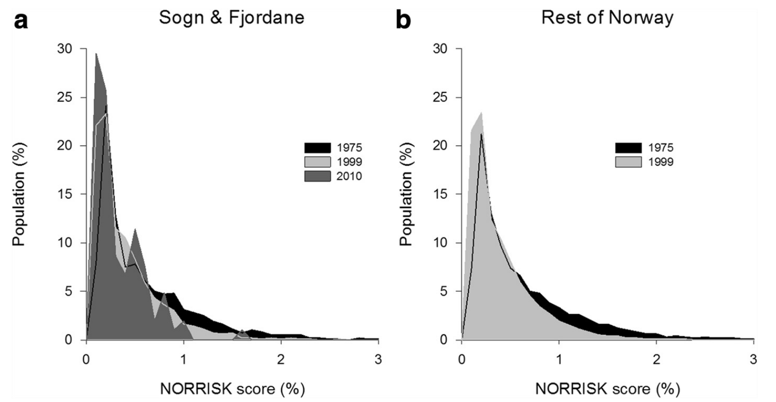

Figure 3 The NORRISK score. The distribution of total CVD risk (%) in **(a)** Sogn & Fjordane 1975-2010 and **(b)** the rest of Norway 1975-1999.

might be the result of a delayed development in an already healthy population. In Norway, the substantial decrease in BP in the late 1990s has previously been discussed as a possible methodological issue, at least in part [24]. The use of antihypertensive medications has increased from 2004–2010 [30], but in 2010 there was no difference between Sogn & Fjordane and the rest of the country (data not shown).

There is no significant difference in the TC trend between Sogn & Fjordane and the rest of Norway. With regard to HDL-c however, the trend in Sogn & Fjordane is slightly more beneficial, which may be explained by the more beneficial LTPA. Lipid data from the 2008 HUNT study [31] revealed that TC levels were similar for men but lower for women in Sogn & Fjordane than in central Norway and that HDL-c levels were higher for both men and women in Sogn & Fjordane. The higher BMI in central Norway could be a possible explanation. However, the possible overrepresentation of a physically active population in the 2010 cohort could explain both the lower BMI and the more beneficial lipid levels in Sogn & Fjordane compared with the HUNT population.

The nationwide decrease in total CVD risk expressed by the NORRISK score indicates that the CVD risk profile in Norway has improved over time. The less beneficial trend in Sogn & Fjordane, however, may indicate that the healthy population is becoming more similar to the rest of Norway. In addition, the differences between counties in total and CVD mortality have decreased in recent decades [4].

Strengths and limitations

The long time span (including eight cohorts), the large populations with high participation rates in the majority of the cohorts and consistent measurement and analyses used for most variables are strengths of this study.

The study also has limitations. First, the number of participants and the participation rate in the 2010 cohort introduced uncertainty regarding the most recent period and could be a source of selection bias. Second, investigating trends over a 35-year span provides measurement challenges. Multiple BP devices have been used, but device comparisons have been performed to minimize potential bias and to correct for the instruments used. The use of self-reported weight and height for parts of the population in 2010 creates some uncertainty. However, tests of agreement between the self-reported and measured weights and heights from 2010 produced satisfactory results, and adjusting for the measurement method yielded results similar to the crude rates. In addition, using self-reported LTPA is a potential source of recall and social desirability bias [32]. Although the questions were slightly modified to adapt to one's perception of terms, uncertainty related to changes over time in the participants' interpretation of the term LTPA remains to some degree [6,32]. However, currently no data are available from investigations of secular trends in LTPA using objective measurements in Norwegian adults. Interaction with sex was found for BMI, SBP, DBP, TC, HDL-c, smoking, sedentary behavior and vigorous PA. Descriptive data are presented for both sexes. However, due to less evident interactions for the majority of the variables and for the readability, trend data in tables are presented in total, whereas trends for men and women are presented separately in text where appropriate.

Conclusions

In sum, we found that the LTPA level has been relatively stable over a 35-year period, also in Sogn & Fjordane, the county that has been considered the healthiest in Norway. Upward trends were observed in light and vigorous PA, whereas a downward trend was observed in moderate PA. For sedentary behavior, an upward trend was observed in men, whereas a downward trend was observed in women. With respect to smoking, BP and cholesterol decreasing trends were found, but increasing trends were observed in BMI and TG. Compared with the national data, the trends in Sogn & Fjordane were more beneficial for TG, HDL-c and BMI but less beneficial for BP.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

AKS participated in the design of the study, drafted the manuscript and performed the statistical analysis and data interpretation. IMH participated in the design of the study and contributed to the statistical analysis. SGI participated in the design of the study. GKR participated in the design of the study. EA contributed to the statistical analysis. SAA was the lead investigator and participated in the design of the study. All authors contributed to writing the manuscript, the data interpretation and read and approved the final manuscript.

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References

1. Bjartveit K, Foss OP, Gjervig T, Lund-Larsen PG: The cardiovascular disease study in Norwegian counties. Background and organization. *Acta Med Scand Suppl* 1979, **634**:1–70.
2. Fylkesspegelen [County statistics]. [http://www.sfj.no/cmssff/cmspublish.nsf/pages/Statistikk_og_analyse]
3. Befolkningsstatistikk: Ekteskap og Skilsmisser [Population Statistics - Marriage and Divorce]. [http://www.ssb.no/ekteskap/]
4. Folkehelsebarometeret [Public Health Profile]. [http://khp.fhi.no/]
5. Wøien G, Øyen O, Graff-Iversen S: 22 years of cardiovascular surveys in Norwegian counties. Is the development in risk factors satisfactory? *Nor J Epidemiol* 1997, **7**:255–266.
6. Anderssen SA, Engeland A, Sogaard AJ, Nystad W, Graff-Iversen S, Holme I: Changes in physical activity behavior and the development of body mass index during the last 30 years in Norway. *Scand J Med Sci Sports* 2008, **18**:309–317.
7. Borodulin K, Laatikainen T, Juolevi A, Jousilahti P: Thirty-year trends of physical activity in relation to age, calendar time and birth cohort in Finnish adults. *Eur J Public Health* 2008, **18**:339–344.
8. Bauman A, Armstrong T, Davies J, Owen N, Brown W, Bellew B, Vita P: Trends in physical activity participation and the impact of integrated campaigns among Australian adults, 1997–99. *Aust N Z J Public Health* 2003, **27**:76–79.
9. Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U: Lancet physical activity series working G: global physical activity levels: surveillance progress, pitfalls, and prospects. *Lancet* 2012, **380**:247–257.
10. Jenum AK, Graff-Iversen S, Selmer R, Sogaard AJ: [Risk factors for cardiovascular disease and diabetes through three decades]. *Tidsskr Nor Laegeforen* 2007, **127**:2532–2536.
11. Meyer HE, Tverdal A: Development of body weight in the Norwegian population. *Prostaglandins Leukot Essent Fat Acids* 2005, **73**:3–7.
12. Midthjell KLCMY, Langhammer A, Krogstad S, Holmen TL, Hveem K, Colaguri S, Holmen J: Trends in overweight and obesity over 22 years in a large adult population: the HUNT Study, Norway. *Clin Obes* 2013, **3**:12–20.
13. Finucane MM, Stevens GA, Cowan MJ, Danaei G, Lin JK, Paciorek CJ, Singh GM, Gutierrez HR, Lu Y, Bahalim AN, Farzadfar F, Riley LM, Ezzati M: National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. *Lancet* 2011, **377**:557–567.
14. Danaei G, Finucane MM, Lin JK, Singh GM, Paciorek CJ, Cowan MJ, Farzadfar F, Stevens GA, Lim SS, Riley LM, Ezzati M: National, regional, and global trends in systolic blood pressure since 1980: systematic analysis of health examination surveys and epidemiological studies with 786 country-years and 5.4 million participants. *Lancet* 2011, **377**:568–577.
15. Farzadfar F, Finucane MM, Danaei G, Pelizzari PM, Cowan MJ, Paciorek CJ, Singh GM, Lin JK, Stevens GA, Riley LM, Ezzati M: National, regional, and global trends in serum total cholesterol since 1980: systematic analysis of health examination surveys and epidemiological studies with 321 country-years and 3.0 million participants. *Lancet* 2011, **377**:578–586.
16. Hansen BH, Kolle E, Dyrstad SM, Holme I, Anderssen SA: Accelerometer-determined physical activity in adults and older people. *Med Sci Sports Exerc* 2011, **44**:266–272.
17. Solbraa AK, Mamen A, Resaland GK, Steene-Johannessen J, Ylvisåker E, Holme IM, Anderssen SA: Level of physical activity, cardiorespiratory fitness and cardiovascular disease risk factors in a rural adult population in Sogn og Fjordane. *Nor J Epidemiol* 2011, **20**:179–188.
18. Saltin B, Grimsby G: Physiological analysis of middle-aged and old former athletes. *Circulation* 1968, **38**:1104–1115.
19. Wilhelmsen L, Tibblin G, Aurell M, Bjure J, Ekstrom-Jodal B, Grimby G: Physical activity, physical fitness and risk of myocardial infarction. *Adv Cardiol* 1976, **18**:217–230.
20. CONOR web page. [http://www.fhi.no/eway/default.aspx?pid=238&trg=MainLeft_5853&MainArea_5811=5853:0:15,2818:1:0:0:::0:0 &MainLeft_5853=5825:56612::1:5857:2:::0:0]
21. Bjartveit K, Wøien G: *Cardiovascular disease risk factors in Norway - Results from surveys in 18 counties.* Oslo: National Health Screening Services; 1997.
22. Tonstad S, Graff-Iversen S: Action levels for obesity treatment in 40 to 42-y-old men and women compared with action levels for prevention of coronary heart disease. *Int J Obes Relat Metab Disord* 2001, **25**:1698–1704.
23. Lund-Larsen PG: Blodtrykk målt med kvikksølvmanometer og med Dinamap under feltforhold - en sammenligning [Blood pressure measured with a sphygmomanometer and with Dinamap under field conditions – a comparison]. *Nor J Epidemiol* 1997, **7**:235–241.
24. Tverdal A: Significant decline in blood pressure levels after 1996–fact or artefact? *Tidsskr Nor Laegeforen* 2001, **121**:1821–1825.
25. Edvardsen E, Hansen BH, Holme IM, Dyrstad SM, Anderssen SA: Reference values for cardiorespiratory response and fitness on the treadmill in a 20-85-year-old population. *Chest* 2013, **144**:241–248.
26. Selmer R, Lindman AS, Tverdal A, Pedersen JI, Njolstad I, Veierod MB: [Model for estimation of cardiovascular risk in Norway]. *Tidsskr Nor Laegeforen* 2008, **128**:286–290.
27. Rose G: Sick individuals and sick populations. *Int J Epidemiol* 2001, **30**:427–432. discussion 433–424.
28. Graff-Iversen S, Skurtveit S, Nybo A, Ross GB: [Trends when it comes to occupational physical activity among Norwegians aged 40–42 years during the period 1974–94]. *Tidsskr Nor Laegeforen* 2001, **121**:2584–2588.
29. Flegal KM, Carroll MD, Kit BK, Ogden CL: Prevalence of obesity and trends in the distribution of body mass index among US adults, 1999–2010. *JAMA* 2012, **307**:491–497.
30. Norwegian prescription database. [http://www.norpd.no/Prevalens.aspx]
31. Aspenes ST, Nilsen TIL, Skaug E-A, Bertheussen GF, Ellingsen Ø, Vatten L, WislØFf U: Peak oxygen uptake and cardiovascular risk factors in 4631 healthy women and men. *Med Sci Sports Exerc* 2011, **43**:1465–1473.
32. Warren JM, Ekelund U, Besson H, Mezzani A, Geladas N, Vanhees L: Assessment of physical activity - a review of methodologies with reference to epidemiological research: a report of the exercise physiology section of the European Association of Cardiovascular Prevention and Rehabilitation. *Eur J Cardiovasc Prev Rehabil* 2010, **17**:127–139.

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Paper III

Long-term correlates of objectively measured physical activity and sedentary time in Norwegian men and women

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Abstract

Background: Sex, age, body mass index (BMI), perceived health and health behavior are correlates known to affect physical activity and sedentary time. However, studies have often been cross-sectional, and less is known about long-term correlates. Thus, the aims were to investigate 1) the associations between a set of characteristics (demographic, biological, psychological and behavioral) and objectively measured physical activity and sedentary time at 13 year follow-up, and 2) the association between changes in these characteristics over time and physical activity and sedentary time. **Methods:** Baseline characteristics were collected in 40-year-olds in 1996, and follow-up data on objectively measured physical activity and sedentary time were obtained in 2009 (n=240). Data were analyzed by multiple linear regressions. **Results:** Self-reported physical activity (p<0.001) and improved perceived health (p=0.046) were positively associated with moderate-to-vigorous physical activity (MVPA) whereas BMI (p=0.034) and increased BMI (p=0.014) were negatively associated with MVPA at follow-up. Women spent less time being sedentary than men (p=0.019). Education (p<0.001) was positively associated and improved perceived health (p=0.010) was negatively associated with sedentary time at follow-up. **Conclusions:** MVPA and sedentary time at follow-up were associated with behavioral, biological and demographic correlates. However, the nature of our analyses prevents us from inferring causality.

Background

Given the considerable literature supporting the beneficial impact of physical activity for preventing non-communicable diseases,[1-4] it is important that people engage in habitual physical activity. Despite the paucity of objective data on sedentary time from prospective observational studies, recent studies have also suggested that sedentary behavior is a population-wide, ubiquitous health risk independent of leisure-time physical activity.[5-8]

Cross-sectional studies indicate that globally, a substantial proportion of people are insufficiently physically active to maintain good health.[9-12] Understanding why some people are more physically active than others is essential for developing public health interventions aimed at increasing physical activity and decreasing sedentary time.[13] Previous studies have suggested education level,[13-15] health status,[13,14] intention to change behavior,[13,15,16] physical activity earlier in life (tracking),[13-18] sex, body mass index (BMI), smoking,[15,18,19] and psychosocial factors[13] as correlates of physical activity. However, most studies have used cross-sectional designs, and prospective observational studies examining the association between these correlates and objectively measured physical activity and sedentary time are few in number.[13-15,20] Moreover, most previous research has usually considered leisure-time physical activity, which may constitute a small part of overall physical activity.[13,15]

Therefore, this study aimed to extend the existing knowledge by examining 1) the associations between a set of characteristics (demographic, biological, psychological and behavioral) and objectively measured physical activity and sedentary time at 13 year follow-up, and 2) the association between changes in these characteristics over time and physical activity and sedentary time at follow-up.

Methods

Population

This study is based on data from The Age 40-Program organized by the National Health Screening Service in 1996[21] (referred to as baseline) and The Physical Activity among Adults and Older People Study in 2009[22] (referred to as follow-up). Both studies invited all men and women born between 1954 and 1956, age 40–42 at baseline, in three municipalities in the rural county Sogn & Fjordane in the western part of Norway (N=565 at baseline and 543 at follow-up).[21,22] At follow-up, participants (age 53–55) were asked to provide consent to link their data to their previously collected baseline data. We included all participants with valid data at both baseline and follow-up, which in total yielded 240 eligible participants (52% of the original sample; 44% men). An overview of the participants is displayed in Figure 1. The study was approved by the Regional Committee for Medical Research Ethics, the Norwegian Social Science Data Services AS and the Norwegian Tax Department. The Norwegian Institute of Public Health gave their approval to use the data from The Age 40-Program.

Baseline measurements

At baseline, height and weight were measured according to standardized procedures to the nearest cm and 0.5 kg, respectively.[23,24] BMI was calculated as participants' weight divided by their height squared (kg/m^2). Perceived health, musculoskeletal pain and stiffness, psychological complaints, intention to improve diet and increase physical activity, smoking habits, physical activity and education level were assessed by self-report, as previously described.[21,25] The instruments have been used in population based screening programs since the 1970s and discriminate well.[25] The use of standardized and unchanged procedures and methods have been emphasized to ensure comparability between cohorts.[26] Physical activity was assessed using the Cohort of Norway (CONOR) instrument, which asked for a weekly average of physical activity during leisure-time over the last year. The duration was quantified on a four-category scale (none, < 1 h, 1–2 h and ≥3 h per week) for light activity (not sweating/not out of breath) and vigorous physical activity (sweating/out of breath).[27,28] For this study, physical activity was categorized into 1) light (any duration of light physical activity or <1 hour of physical activity per week), 2) moderate (1–2 hours of vigorous physical activity per week) and 3) vigorous physical activity (3 or more hours of vigorous activity per week). Highest completed education level was assessed with a five-category scale[21] and later collapsed into the following categories: 1) less than high school, 2) high school, 3) college or university <4 years and 4) college or university ≥4 years. Descriptions of the various baseline characteristics are displayed in Table 1.

Follow-up measurements

At follow-up in 2009, physical activity level was measured objectively with the ActiGraph GT1M accelerometer (ActiGraph, LLC, Pensacola, Florida, USA). The participants were instructed to wear the monitor above the right hip during all waking hours for seven consecutive days, except during water activities and showering. A SAS-based software program (SAS-Institute Inc, Cary, North Carolina, USA) called CSA Analyzer (csa.svenssonspork.dk) was used for data reduction. Epoch length was set to 10 seconds and later collapsed into 60-second epochs for comparisons with other studies. All night activity (between 00:00 and 06:00) and all sequences of at least 60 minutes of consecutive zero counts, with allowance for interruptions of 1–2 minutes of counts above zero, were excluded from each individual's recording. Participants with valid wear time of at least 10 hours for at least four days were included in further analyses. Accelerometer data were summarized as time spent per day in moderate-to-vigorous physical activity (MVPA, counts per minute (cpm) ≥2020) and sedentary time (cpm <100).[29] Additionally, perceived health, education level, smoking habits and physical activity were self-reported using the same questionnaire as the one used for the baseline data. At follow-up, height and weight were both measured and self-reported for approximately 33% of the participants and only self-reported for the remaining sample. For those who provided both self-reported and measured BMI at follow-up, the Bland Altman plot showed individual differences (95%

limits of agreement: -3.28, 1. 98 (intraclass correlation (ICC) =0.952) for women and -2.28, 2.14 (ICC=0.953) for men). The mean difference (standard deviation, SD) between self-reported and measured BMI was -0.65 (1.34) kg/m^2 ($p<0.001$) for women and -0.07 (1.13) kg/m^2 ($p=0.604$) for men. Adjusting for the measurement method yielded results similar to those for the non-adjusted associations (data not shown).

Change in the characteristics from baseline to follow-up in BMI, perceived health, smoking and education level were calculated and is presented in Table 1.

Statistics

Participants' characteristics combined and stratified by sex (where applicable) are presented as mean and SD or numbers and proportion. Student's t-test for independent groups (for continuous variables) and chi-square tests (for proportions) were employed to identify any differences between sexes and between participants and drop-outs. Multiple linear regression analyses were performed to assess any associations between a set of characteristics (sex, baseline BMI, perceived health, musculoskeletal pain and stiffness, psychological complaints, intention to improve diet or increase physical activity level, smoking, self-reported physical activity and changes in BMI, perceived health, smoking and education level), which were the independent variables, and objectively measured MVPA and sedentary time at follow-up, the dependent variables. Preliminary analyses were conducted to ensure that there was no violation of the assumptions of linear regression. Based on literature and theoretical knowledge, all variables were included in a full model. Because of the high correlations between the psychological complaint variables, a latent variable was created using categorical principal component analysis.[30] Lower scores indicated better mental health. Results are presented as regression coefficients (β), 95% confidence intervals (CI) and p-values. Linearity between the independent and dependent variables was assessed prior to performing the analyses. The residuals were normally distributed in both models. We found no sex-specific associations (results not shown), and results are therefore presented combined and adjusted for sex. A Bland

Altman plot[31] and ICC were used to test the agreement between the anthropometric measurement methods. All statistical analyses were performed using the IBM Statistical Package for the Social Sciences (IBM SPSS) version 20.0 (IBM Corporation, Somers, NY, USA).

Results

Baseline data

Descriptive baseline data are displayed in Table 2. Significantly more men (62%) than women (39%) were overweight or obese (BMI $\geq$25 kg/m^2) (p=0.003). In total, 89% of the participants reported their health to be good or very good, whereas 24% of the participants reported musculoskeletal pain and stiffness, with no significant differences between men and women. In total, 53% reported the intention to improve their diets (no significant differences between sexes), but significantly more women (74%) than men (61%) reported the intention to increase their physical activity levels (p=0.030). Twenty percent of the participants were smokers. In total, the majority (63%) reported education levels in the two lowest groups (i.e., completed high-school or less). Approximately 46% reported moderate to vigorous activity levels at baseline. Men reported significantly higher levels of physical activity than did women (p=0.006).

Follow-up data and changes over time

At follow-up, the mean BMI was 26.8 (3.9) kg/m^2 for men and 25.2 (3.9) kg/m^2 for women (p<0.001). Consistent with the baseline findings, significantly more men (66%) than women (48%) were overweight or obese (p=0.021). Men spent significantly more time sedentary than did women (546.0 (87.3) min/day vs. 511.5 (82.9) min/day, p=0.002). However, no significant sex difference (p=0.454) was found for time spent in MVPA (43.4 (25.3) min/day for both sexes). Between baseline and follow-up (Table 2), BMI increased by 0.8 kg/m^2 (men and women combined), 14% of participants reported improvement in perceived health and 8% had quit smoking. Significantly more women (p=0.019) had increased their education levels compared with men (18% vs. 7%).

Long-term associations with MVPA and sedentary time

Self-reported physical activity at baseline (β 8.79, $p<0.001$) and improved perceived health from baseline to follow-up (β 6.09, $p=0.046$) were positively associated with MVPA at follow-up in a graded manner (Table 3). Each unit of difference BMI at baseline (β -1.00, $p=0.034$) and each unit of increase in BMI from baseline to follow-up (β -1.94, $p=0.014$) were negatively associated with MVPA at follow-up (Table 3). Sex was associated with sedentary time at follow-up as women spent less time being sedentary than did men (β -28.76, $p=0.019$). Educational level at baseline was positively associated with time spent sedentary at follow-up in a graded manner (β 27.29, $p<0.001$), whereas improved perceived health from baseline to follow-up was negatively and graded associated with time spent sedentary at follow-up (β -27.18, $p=0.010$) (Table 4). The correlates explained 15.7% and 12.9% of the variance in MVPA and sedentary time, respectively.

Discussion

The results from the present study, which comprised 240 Norwegian men and women who were followed after 13 years, suggest that higher self-reported physical activity levels and lower BMI at baseline and less increase in BMI and improvement in perceived health from baseline to follow-up were associated with more time spent in MVPA at follow-up. Moreover, being a man, higher education level at baseline and perceived worsening in health from baseline to follow-up were associated with more time spent sedentary at follow-up.

Physical activity levels appear to remain stable within groups over time, as determined by what is typically referred to as tracking.[13-17] Studies based on both self-reported[18] and objectively measured[14] physical activity have found an association between physical activity earlier in life and levels of physical activity later in life. Although most studies report low to moderate tracking of physical activity,[16,18,32] the importance of establishing health-enhancing behaviors such as physical activity early in life has been emphasized.[17] However, the differences between studies on how physical activity is assessed and categorized are considerable, which hinders interpretation and comparison between studies. Our finding corroborate and partly extend these previous studies by suggesting that previously self-reported physical activity is associated with later levels of objectively measured physical activity.

We also observed that both lower baseline BMI and less increase in BMI were associated with higher physical activity later in life, consistent with some[14,15] but not all[18] previous observations. The association between BMI and physical activity is most likely bidirectional because habitual physical activity across the life course is associated with lower weight gain[33] but obesity is also a determinant of lower levels of physical activity.[14] We did not observe any association between perceived health at baseline and physical activity, as previously reported.[14,18] This may be explained by the differences in participant ages between the study populations and different measures of physical activity and perceived health.[14,18] Nevertheless, we observed that improved perceived health from baseline to follow-up was associated with both an increase in physical activity and a decrease in time spent sedentary. Thus, present perceived health seems more important for PA than perceived health in the past.

Although education level has been found to be positively associated with physical activity,[13-15] the association has not been consistent in prospective studies,[34] which corroborates our observations. Contrary to previous observations,[14,18] we found a positive association between education level and time spent sedentary. Other studies[14] that also employed an objective measure of sedentary time found that participants with higher education levels compared with those with the lowest levels recorded 42 min/day less sedentary time. Kirjonen et al[18] suggested that limited education was associated with an increased probability of remaining sedentary. Differences between studies may be explained by differences in the study populations. For example, Hamer et al[14] examined these associations in a healthy, fairly homogeneous sample that was participating in the Whitehall study, whereas our participants were living in rural Norway. Generally, it is likely that individuals with higher education levels may tend to have sedentary desk-based work, which may contribute to their higher overall time spent being sedentary.

Our observation suggesting more sedentary time among men compared with women corroborates previous observations that used objective measures of sedentary time.[10,12] We could hypothesis that differences in education level could explain this association; however, no significant difference in education level was observed between the sexes at baseline or follow-up. Several[10,15] but not all[12] studies that used either self-reported or objectively measured physical activity have found more time spent in MVPA among men compared with women. We did not observe a sex difference in MVPA. In contrast with other studies,[13-16,19] we also did not observe any significant associations between MVPA and sedentary time and intention to change behavior, smoking or psychological factors.

Our participants spent less time sedentary and had accumulated more MVPA at follow-up compared with Norwegian, Swedish and US population data.[10,11] Higher levels of physical activity and less time spent sedentary have been observed in those living in this specific area of western Norway for decades.[35] Although this population still appears to be more physically active and less sedentary than other population groups, it is unlikely that this difference in activity levels substantially affected the observed associations between the correlates and the outcomes.

Strengths and limitations

This study's strengths include the 13-year follow-up in the prospective design and the objective assessment of physical activity and sedentary time at follow-up. Objective measurements of physical activity provide more detailed information on time spent in MVPA and sedentary time and are less prone to bias attributable to misreporting or social desirability compared with self-reported physical activity levels.[20]

However, some limitations need to be taken into account when interpreting these results. First, the lack of objective measures of physical activity at baseline, which limited our analyses, prevents us from inferring causality based on our observations. The correlates included in our models only explained a small proportion of the variance in MVPA (16%) and sedentary time (13%) at follow-up. Self-reported exposure variables may be prone to misconceptions and measurement errors, which may have attenuated the observed associations.[36] For example, the association between objectively measured MVPA and self-reported physical activity at follow-up was weak, although it did agree with many previous observations (ρ=0.27, R^2=0.07).[37-39] Additionally, limitations associated with measuring physical activity levels and sedentary time by accelerometry should be acknowledged. For example, accelerometry has known limitations in assessing physical activity during specific types of activities and in assessing sedentary time, and challenges regarding data reduction do exist.[40,41] The variation in wear time is also a limitation when interpreting the data. However, using the percentages of MVPA time and sedentary time as the outcome variables did not materially change our findings. Nearly half of our baseline sample (48%) was lost to follow-up. Dropout analysis showed that nonparticipants at follow-up were more likely to be men (p=0.036) and smokers (p<0.001) and to have higher BMIs (p=0.012) and lower physical activity levels (p=0.003) at baseline. The loss to follow-up could be a source to selection bias. Thus, our results should be interpreted with this in mind. Finally, a number of correlates from multiple domains have been suggested as being associated with physical activity levels and sedentary time in adults.[13] This study only included a limited number of these correlates and domains. It is recommended that future studies include objective measures of physical activity and sedentary time at baseline and follow-up to avoid the measurement errors associated with self-reports, information on physical activity in different contexts and a broad range of correlates from multiple domains.

Conclusions

Our results suggest that higher baseline levels of physical activity, lower baseline BMIs, less increase in BMIs and improved perceived health were associated with increased time spent in MVPA 13 years later. Being female, having lower baseline education levels and improved perceived health were associated with decreased time spent sedentary. However, the correlates included in the present study only explained 16% and 13% of the variance in MVPA and sedentary time, respectively, and the results should therefore be interpreted with caution.

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References

1. Vuori I. Physical activity and cardiovascular disease prevention in Europe: An update. *Kinesiology.* 2010;42(1):5-15.
2. Hu G, Tuomilehto J, Silventoinen K, Barengo N, Jousilahti P. Joint effects of physical activity, body mass index, waist circumference and waist-to-hip ratio with the risk of cardiovascular disease among middle-aged Finnish men and women. *Eur Heart J.* 2004;25(24):2212-2219.
3. Aadahl M, Kjaer M, Jorgensen T. Associations between overall physical activity level and cardiovascular risk factors in an adult population. *Eur J Epidemiol.* 2007;22(6):369-378.
4. Luke A, Dugas LR, Durazo-Arvizu RA, Cao G, Cooper RS. Assessing physical activity and its relationship to cardiovascular risk factors: NHANES 2003-2006. *BMC Public Health.* 2011;11:387.
5. Ford ES, Caspersen CJ. Sedentary behaviour and cardiovascular disease: a review of prospective studies. *Int J Epidemiol.* 2012;41(5):1338-1353.
6. Dunstan DW, Thorp AA, Healy GN. Prolonged sitting: is it a distinct coronary heart disease risk factor? *Curr Opin Cardiol.* Sep 2011;26(5):412-419.
7. Veerman JL, Healy GN, Cobiac LJ, et al. Television viewing time and reduced life expectancy: a life table analysis. *BJSM online.* Oct 2012;46(13):927-930.
8. Aadland E, Andersen JR, Anderssen SA, Kvalheim OM. Physical activity versus sedentary behavior: associations with lipoprotein particle subclass concentrations in healthy adults. *PLoS ONE [Electronic Resource].* 2013;8(12):e85223.
9. Hallal PC, Andersen LB, Bull FC, et al. Global physical activity levels: surveillance progress, pitfalls, and prospects. *Lancet.* 2012;380(9838):247-257.
10. Hansen BH, Kolle E, Dyrstad SM, Holme I, Anderssen SA. Accelerometer-Determined Physical Activity in Adults and Older People. *Med Sci Sports Exerc.* 2012;44(2):266-272.

11. Hagstromer M, Troiano RP, Sjostrom M, Berrigan D. Levels and patterns of objectively assessed physical activity--a comparison between Sweden and the United States. *Am. J Epidemiol.* 2010;171(10):1055-1064.

12. Baptista F, Santos DA, Silva AM, et al. Prevalence of the Portuguese population attaining sufficient physical activity. *Med Sci Sports Exerc.* 2012;44(3):466-473.

13. Bauman AE, Reis RS, Sallis JF, et al. Correlates of physical activity: why are some people physically active and others not? *Lancet.* 2012;380(9838):258-271.

14. Hamer M, Kivimaki M, Steptoe A. Longitudinal patterns in physical activity and sedentary behaviour from mid-life to early old age: a substudy of the Whitehall II cohort. *J Epidemiol Community Health.* 2012;66(12):1110-1115.

15. Trost SG, Owen N, Bauman AE, Sallis JF, Brown W. Correlates of adults' participation in physical activity: review and update. *Med Sci Sports Exerc.* 2002;34(12):1996-2001.

16. Morseth B, Jorgensen L, Emaus N, Jacobsen BK, Wilsgaard T. Tracking of leisure time physical activity during 28 yr in adults: the Tromso study. *Med Sci Sports Exerc.* 2011;43(7):1229-1234.

17. Telama R, Yang X, Viikari J, Valimaki I, Wanne O, Raitakari O. Physical activity from childhood to adulthood: a 21-year tracking study. *American Journal of Preventive Medicine.* 2005;28(3):267-273.

18. Kirjonen J, Telama R, Luukkonen R, Kaaria S, Kaila-Kangas L, Leino-Arjas P. Stability and prediction of physical activity in 5-, 10-, and 28-year follow-up studies among industrial employees. *Scandinavian Journal of Medicine & Science in Sports.* 2006;16(3):201-208.

19. Kvaavik E, Meyer HE, Tverdal A. Food habits, physical activity and body mass index in relation to smoking status in 40-42 year old Norwegian women and men. *Prev.Med.* 2004;38(1):1-5.

20. Warren JM, Ekelund U, Besson H, Mezzani A, Geladas N, Vanhees L. Assessment of physical activity - a review of methodologies with reference to epidemiological research: a report of the exercise physiology section of the European Association of Cardiovascular Prevention and Rehabilitation. *Eur J Cardiovasc. Prev. Rehabil.* 2010;17(2):127-139.

21. Wøien G, Øyen O, Graff-Iversen S. 22 years of cardiovascular surveys in Norwegian counties. Is the development in risk factors satisfactory? *Nor J Epidemiol.* 1997;7(2):255-266.

22. Solbraa AK, Mamen A, Resaland GK, et al. Level of physical activity, cardiorespiratory fitness and cardiovascular disease risk factors in a rural adult population in Sogn og Fjordane. *Nor J Epidemiol.* 2011;20(2):179-188.

23. Bjartveit K, Wøien G. *Cardiovascular disease risk factors in Norway - Results from surveys in 18 counties.* National Health Screening Services: Oslo; 1997.

24. Tonstad S, Graff-Iversen S. Action levels for obesity treatment in 40 to 42-y-old men and women compared with action levels for prevention of coronary heart disease. *Int. J. Obes. Relat Metab Disord.* 2001;25(11):1698-1704.

25. Bjartveit K, Foss OP, Gjervig T, Lund-Larsen PG. The cardiovascular disease study in Norwegian counties. Background and organization. *Acta Med Scand Suppl.* 1979;634:1-70.

26. Bjartveit K, Stensvold I, Lund-Larsen PG, Graff-Iversen S, Urdal P. [Cardiovascular disease prevention programmes in Norwegian counties. Trends in risk pattern among persons aged 40-42 in four counties, 1985-90]. *Tidsskr Nor Laegeforen.* 1991;111(17):2072-2076.

27. Graff-Iversen S, Anderssen SA, Holme IM, Jenum AK, Raastad T. Two short questionnaires on leisure-time physical activity compared with serum lipids, anthropometric measurements and aerobic power in a suburban population from Oslo, Norway. *Eur J Epidemiol.* 2008;23(3):167-174.

28. Norwegian Institute of Public Health. CONOR web page. http://www.fhi.no/eway/default.aspx?pid=238&trg=MainLeft_5853&MainArea_5811=5853:0:15,2818:1:0:0:::0:0&MainLeft_5853=5825:56612::1:5857:2:::0:0. Accessed 1/4, 2013.

29. Metzger JS, Catellier DJ, Evenson KR, Treuth MS, Rosamond WD, Siega-Riz AM. Patterns of objectively measured physical activity in the United States. *Med Sci Sports Exerc.* 2008;40(4):630-638.

30. Linting M, Meulman JJ, Groenen PJ, van der Koojj AJ. Nonlinear principal components analysis: introduction and application. *Psychological methods.* 2007;12(3):336-358.

31. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet.* 1986;i:307-310.

32. Malina RM. Physical activity and fitness: pathways from childhood to adulthood. *American journal of human biology : the official journal of the Human Biology Council.* 2001;13(2):162-172.

33. Hankinson AL, Daviglus ML, Bouchard C, et al. Maintaining a High Physical Activity Level Over 20 Years and Weight Gain. *JAMA.* 2010;304(23):2603-2610.

34. van Stralen MM, De Vries H, Mudde AN, Bolman C, Lechner L. Determinants of initiation and maintenance of physical activity among older adults: a literature review. *Health Psychol Rev.* 2009;3(2):147-207.

35. Graff-Iversen S, Selmer R, Sørensen M, Skurtveit S. Occupational Physical Activity, Overweight, and Mortality: A Follow-up Study of 47,405 Norwegian Women and Men. *Research Quarterly for Exercise & Sport.* 2007;78(3):151-161.

36. Hutcheon JA, Chiolero A, Hanley JA. Random measurement error and regression dilution bias. *BMJ.* 2010;340:c2289.

37. Prince SA, Adamo KB, Hamel ME, Hardt J, Connor Gorber S, Tremblay M. A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *Int J Behav Nutr Phys Act.* 2008;5:56.

38. Helmerhorst HJ, Brage S, Warren J, Besson H, Ekelund U. A systematic review of reliability and objective criterion-related validity of physical activity questionnaires. *Int J Behav Nutr Phys Act* 2012;9:103.

39. Dyrstad SM, Hansen BH, Holme IM, Anderssen SA. Comparison of Self-reported versus Accelerometer-Measured Physical Activity. *Med Sci Sports Exerc.* 2014;46(1):99-106.

40. Matthews CE, Hagstromer M, Pober DM, Bowles HR. Best practices for using physical activity monitors in population-based research. *Med Sci Sports Exerc.* 2012;44(1 Suppl 1):S68-76.

41. Atkin AJ, Gorely T, Clemes SA, et al. Methods of Measurement in epidemiology: sedentary Behaviour. *Int. J Epidemiol.* 2012;41(5):1460-1471.

Table 1. Descriptions of baseline characteristics and change in characteristics from baseline to follow-up.

Characteristics	Instrument	Scoring
BMI	Measured	Kg/m^2
Perceived health	What is your current health status?	1) Poor/Not so good 2) Good 3) Very good
Musculoskeletal pain and stiffness	Have you during the last year suffered from pain and/or stiffness in muscles and joints that has lasted for at least three months?	Yes/No
Psychological complaints	Latent variable on psychological complaints during the last two weeks	Continuous arbitrary unit
Intention to change behavior	During the last 12 months and/or in the next five years, have you attempted to or do you want to: Improve diet Increase physical activity	Yes/No
Smoking	Do you smoke daily?	Yes/No
Physical activity	How has your physical activity during leisure-time been over the last year?	1) Light physical activity 2) Moderate physical activity 3) Vigorous physical activity
Educational level	What is the highest level of education you have completed?	1) Less than high school 2) High school 3) College or university <4yrs 4) College or university ≥4yrs
Δ BMI		Kg/m^2
Δ perceived health		1) Perceived improvement 2) No change 3) Perceived worsening
Δ smoking		1) Quit smoking 2) Never smoked 3) Still smoke 4) Began smoking
Δ education level		1) No change 2) Increased education level

BMI, body mass index; Δ, change from 1996 to 2009

Table 2. Baseline characteristics and change in characteristics, in total and stratified by sex, mean (standard deviation) or number (%).

	All (n=240)	Men (n=105)	Women (n= 135)	p-value for sex difference
Baseline				
BMI (kg/m^2)	25.2 (3.8)	26.3 (3.5)	24.3 (3.7)	<0.001
Perceived health, n (%)				0.522
Poor or not so good	26 (10.8)	14 (13.3)	12 (8.9)	
Good	160 (66.7)	69 (65.7)	91 (67.4)	
Very good	54 (22.5)	22 (21.0)	32 (23.7)	
Musculoskeletal pain and stiffness, n (%)	57 (23.8)	26 (24.8)	31 (23.0)	0.745
Psychological complaints (arbitrary unit)	0.02 (1.02)	0.03 (1.22)	0.004 (0.845)	0.838
Intention to change during the last 12 months or in the next five years, n (%)				
Intention to improve diet	127 (52.9)	52 (49.5)	75 (55.6)	0.353
Intention to increase physical activity	164 (68.3)	64 (61.0)	100 (74.1)	0.030
Smoking, n (%)	48 (20.0)	27 (25.7)	21 (15.6)	0.051
Highest completed education level, n (%)				0.365
Less than high school	122 (50.8)	55 (52.4)	67 (49.6)	
High school	28 (11.7)	8 (7.6)	20 (14.8)	
College or university <4yrs	47 (19.6)	21 (20.0)	26 (19.3)	
College or university ≥4yrs	43 (17.9)	21 (20.0)	22 (16.3)	
Self-reported physical activity, n (%)				0.006
Light	129 (54.0)	50 (48.1)	79 (58.5)	
Moderate	82 (34.3)	34 (32.7)	48 (35.6)	
Vigorous	28 (11.7)	20 (19.2)	8 (5.9)	
Change from baseline to follow-up				
Δ BMI (kg/m^2)	0.8 (2.1)	0.6 (2.0)	0.9 (2.2)	0.369
Δ Perceived health, n (%)				0.215
Perceived improvement	33 (13.8)	18 (17.3)	15 (11.1)	
No change	145 (60.7)	57 (54.8)	88 (65.2)	
Perceived worsening	61 (25.5)	29 (27.9)	32 (23.7)	
Δ Smoking, n (%)				0.189
Quit smoking	18 (7.6)	11 (10.7)	7 (5.2)	
Never smoked	185 (78.1)	77 (74.8)	108 (80.6)	
Still smoke	28 (11.8)	14 (13.6)	14 (10.4)	
Began smoking	6 (2.5)	1 (1.0)	5 (3.7)	
Δ Education level, n (%)				0.019
No change	200 (87.0)	92 (92.9)	108 (82.4)	
Increased education level	30 (12.0)	7 (7.1)	23 (17.6)	

BMI, body mass index; Δ, change from 1996 to 2009

Table 3. Long-term associations of moderate-to-vigorous physical activity (MVPA) (min/day).

	MVPA (min/day)			
	β	**p-value**	**95% CI**	**R^{2a}**
				0.157
BMI (kg/m^2)	-1.00	0.034	(-1.91,-0.08)	
Self-reported PA	8.79	<0.001	(4.07,13.51)	
Δ BMI	-1.94	0.014	(-3.47,-0.40)	
Δ Perceived health	6.09	0.046	(0.12,12.06)	

[a] Adjusted

β, regression coefficient; BMI, body mass index; PA, physical activity; Δ, change from 1996 to 2009

Table 4. Long-term associations of sedentary time (SED) (min/day).

	SED (min/day)			
	β	**p-value**	**95% CI**	**R^{2a}**
				0.129
Sex	-28.76	0.019	(-52.77,-4.75)	
Education level	27.29	<0.001	(17.58,37.00)	
Δ Perceived health	-27.18	0.010	(-47.90,-6.46)	

[a] Adjusted

β, regression coefficient; Δ, change from 1996 to 2009

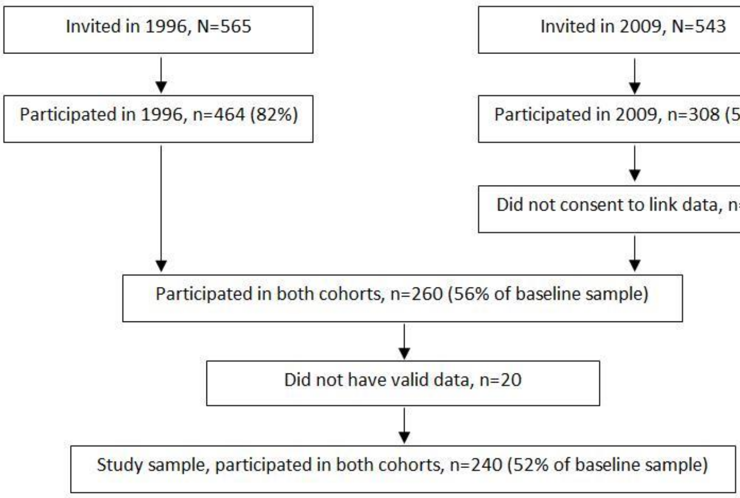

Figure 1. Overview of the study population.

Paper IV

The built environment correlates of objectively measured physical activity in Norwegian adults: a cross-sectional study

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Abstract

Background: Built environments that are designed to provide accessible, attractive, and convenient locales have the potential to enhance physical activity. Within Norway, there is a great variability in physical activity and built environments. In the county of Sogn & Fjordane, located in the west part of Norway, high physical activity levels are observed. Thus, the aim of this study was to explore perceived built environment features and characterize their associations with objectively measured physical activity levels in Norwegian adults, and to explore the differences in these correlates between Sogn & Fjordane and the rest of Norway. **Methods:** In this cross-sectional study, perceived built environments were assessed by questionnaire and physical activity was assessed objectively for seven consecutive days using the ActiGraph GT1M accelerometer. A total of 972 Norwegian adults were included in the study. The average age was 46.9 (6.5) years and 43.8% of participants were men. Data were analyzed by multiple linear regressions. **Results:** Living in Sogn & Fjordane, a community perception score describing their community, a perceived walkability score and active transport for commuting were associated with overall physical activity and moderate-to-vigorous physical activity (MVPA) (all $p \leq 0.004$). Geographic-area-specific associations were observed. Community perception score was associated with overall physical activity and MVPA in the rest of Norway ($p \leq 0.012$) but not in Sogn & Fjordane. Public transport for commuting was associated with MVPA in Sogn & Fjordane ($p=0.03$) but not in the rest of Norway. **Conclusions:** Overall physical activity level and MVPA were associated with built environment factors such as location of residence, perceptions of community, perceived walkability and engaging in active transport for commuting. Geographic differences in the physical activity correlates were observed for community perception and public transport, and thus, locally customized environmental population approaches aimed at increasing physical activity levels may be essential complements to individual behavior and lifestyle strategies.

Keywords: Accelerometry; physical activity; correlates; built environment; walkability; active transport

Background

Built environments that are designed to provide accessible, attractive, and convenient locales positively influence physical activity [1-6]. Factors such as access to key destinations (e.g., shops, services, work, etc.), safety from traffic, degree of urbanization (population density or size of municipality) and quality of the environment (general activity-friendliness) have been observed to relate to total physical activity in a number of western countries [2, 3, 5, 6]. However, built environments may vary from country to country and may be cultural and locally determined [3]. To our knowledge, there are few studies that examine the association between objectively measured physical activity and built environment features in Norway. There is great variability in the geographic and built environment features within Norway, but no study has assessed regional variations. Hence, understanding which features of the built environment provide active living opportunities in a sample of the Norwegian population is crucial for promoting physical activity.

A substantial body of literature highlights the benefits of regular physical activity in preventing non-communicable diseases [7-9]. Worldwide, physical inactivity (i.e., not meeting recommended guidelines for physical activity [10]) is estimated to cause 6–10% of the major non-communicable diseases and 9% of premature deaths. This makes inactivity similar to the established risk factors of smoking and obesity. Importantly, with the elimination of physical inactivity worldwide, life expectancy is expected to increase by 0.68 years. Because all of the gain accrues to people who move from being inactive to active, the increase in life expectancy in the inactive group alone is greater [7]. Despite this knowledge, a large proportion of the world’s population remains physically inactive [11-14]. In Norway, only 31% of the population meet the recommended guidelines for physical activity [14].

There are, however, considerable variations in physical activity levels and health within Norway [15-18]. In particular, for decades, the county of Sogn & Fjordane, located in the west part of Norway, has experienced one of the lowest levels of risk for myocardial infarction [15, 19]. In addition, the county’s residents have higher levels of physical activity [16, 17] and longer life expectancy [18] compared with other regions in Norway. As of 2014, Sogn & Fjordane has a population of approximately 110,000 inhabitants, and people mainly live in small urban areas or are scattered over a wide area. The population density for the region is 5.9 inhabitants/km^2, compared with 13.2 inhabitants/km^2 throughout Norway [20]. In contrast, the population density in England is 407 inhabitants/km^2 [21]. Although the county is dominated by a fjord landscape and mountainsides, there are also varying degrees of urbanization, which could influence outdoor activity patterns.

Based on the knowledge of the influence of built environments on physical activity and the beneficial health status and physical activity levels identified in Sogn & Fjordane, the primary aim of this study was to explore perceived built environment features and characterize their associations with objectively measured physical activity levels in Norwegian adults. The secondary aim was to explore the differences in these correlates between Sogn & Fjordane, a county with few inhabitants, and the rest of Norway.

Methods

Participants

A representative sample of 2462 men and women, born in 1954–56 and 1967–69, from 13 out of 19 counties in Norway were invited via a mailed letter to participate in The Physical Activity among Adults and Older People Study in 2008/2009 (n=1096 from the county of Sogn & Fjordane, n=1366 from the rest of Norway). In the event of nonresponse, participants were contacted by phone and/or mail. Fifty-one invitations were returned because of an unknown address or death; therefore, the eligible sample consisted of 2412 men and women. In total, 1032 adults participated in the study, and 972 adults (40%) provided data with at least one built environment variable: n=590 from Sogn & Fjordane and n=382 from the rest of Norway. The average age was 46.9 (6.5) years and 43.8% of participants were men. The study population is described in greater detail elsewhere [11, 16].

Data collection occurred between May 2008 and December 2009. When signed informed consent was received, a questionnaire and an accelerometer (to objectively measure physical activity) were sent to the participants via mail and returned after use in a prepaid envelope. The study was approved by the Regional Committee for Medical Research Ethics, the Norwegian Social Science Data Services AS and the Norwegian Tax Department.

Measures

Physical activity. Physical activity was measured with the ActiGraph GT1M accelerometer (ActiGraph, LLC, Pensacola, Florida, USA). The accelerometer was initialized and the data were downloaded using the software program ActiLife (ActiGraph, Pensacola, Florida, USA). The participants were instructed to wear the monitor above their right hips during all waking hours for seven consecutive days, except during water activities and showering. The epoch length was set to 10 seconds and reintegrated into 60-second epochs in the analyses for comparison with published literature. All night activity (between 00:00 and 06:00) and all periods of at least 60 minutes of consecutive zero counts, with an allowance for interruptions of one to two minutes of counts above zero, were excluded from each individual's recording [11]. Participants with at least ten hours of physical activity data for at least four days were included in the analyses [22]. Physical activity is presented as overall physical activity (mean counts per minute per day, cpm) and moderate-to-vigorous physical activity (≥2020 cpm, MVPA, min/day) [23]. A SAS-based software program (SAS-Institute Inc, Cary, North Carolina, USA) called CSA Analyzer (csa.svenssonspork.dk) was used for accelerometry data reduction.

Built environment. The inclusion of built environmental correlates was guided by the empirical literature on built environment factors that are associated with physical activity in various settings and populations [6, 24]. Size of home municipality (number of residents) was self-reported, and locations of residences were recorded. Perceived community attributes were measured with a seven-item scale. The participants indicated on a four-point Likert scale the extent to which they agreed or disagreed with statements describing their community (regarding safety of recreation areas and parks, access to physical activity facilities or locations, organized opportunities for physical activity, access to shops, walking and biking facilities, pedestrian street safety and crosswalks and light signals, which make it easier to cross the road) ranging from strongly disagree to strongly agree [25]. The measures showed good internal consistency (α=0.79). A community perception score was calculated by the mean of at least six out of seven items. Perceived walkability was measured with a four-item scale on which participants indicated their walking time from home to the grocery store, a recreational area/park/trail, a gym/swimming pool/sport center/outdoor sport facility and a forest/open field/mountain. A perceived walkability score was calculated by the mean of at least three out of four items. Commuting to work was self-reported by the categories car/motorbike (referred to here as motorized transport), public transport, biking, walking and not applicable. The categories biking and walking were later combined (referred to here as active transport), and participants who responded "not applicable" were excluded from the analysis.

Other variables. Participants were requested to self-report age, sex, education level (less than high school, high school, university <4 years or university ≥4 years), current work status (later categorized into working and not working), height and weight. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). Perceived health was rated as very good, good, either, poor or very poor and later categorized into poor, good and either and entered into the analyses. Smoking was self-reported and dichotomized into yes and no. Self-efficacy for physical activity was measured using a five-item scale on which the participants indicated on a seven-point Likert scale the extent to which they were confident in their ability to perform planned physical activities in the face of potential barriers (I am tired; I feel depressed; I am concerned; I am angry; I feel stressed), ranging from not at all confident to very confident [25]. The measures showed good internal consistency (α=0.91). A self-efficacy score was calculated by the mean of at least three out of five items.

Statistics

Participants' characteristics, stratified by sex and geographic area (Sogn & Fjordane vs. the rest of Norway), were described as means and standard deviations (SD) or as numbers and proportions. Student's t-test for independent groups and chi-square tests for proportions were used to identify differences between sexes and geographic areas. To analyze the association between objectively measured physical activity (dependent variables) and potential correlates for physical activity (independent variables), multiple linear regression analyses were employed. Preliminary analyses were conducted to ensure that there was no violation of the assumptions of linear regression. All associations were adjusted for sex, BMI, education level, smoking, perceived health and mean daily walk time. Interaction with sex and location of residence was tested by including the interaction variables (sex/location of residence*independent variable) in the model together with the other variables. If interaction with sex or location of residence was found, sex-specific and geographic-area-specific associations were presented separately for these variables. The results are presented as regression coefficients (β), p-values and 95% confidence intervals (CI). The residuals were normally distributed in the models. The potential correlates were then ordered by tertiles (below tertile 1: low score, between tertiles 1 and 2: medium score and above tertile 2: high score). Analyses of covariance were used to test the interaction (location of residence*tertiles of potential correlates) in relation to physical activity levels (dependent variable), adjusted for the potential confounders mentioned above (Figure 1a-c). For the categorical variables the interaction variable (location of residence*potential correlates) was used. All statistical analyses were performed using IBM Statistical Package for the Social Sciences (IBM SPSS) version 20.0 (IBM Corporation, Somers, NY, USA).

Results

Sample characteristics

The characteristics of the participants are displayed in Table 1. The majority of the participants were employed in both Sogn & Fjordane (96%) and the rest of Norway (95%). Approximately 80% of the participants in both areas reported their health to be good. In Sogn & Fjordane and the rest of Norway, respectively, 52.7% and 48.3% were overweight or obese, and 17.2% and 19.5% were smokers. The differences were not significant. Compared with the rest of Norway, the population in Sogn & Fjordane was significantly more physically active (43.1 (26.6) min/day vs. 34.4 (23.0) min/day of MVPA, p<0.001) but had completed fewer years of education (50.2% vs. 41.3% having high school education or lower as their highest education, p=0.012). The residents of Sogn & Fjordane lived in less-populated municipalities (99.3% vs. 14.6% living in municipalities with 10,000 inhabitants or fewer, p<0.001) and reported lower community perception scores (3.1 vs. 3.4, p<0.001). Commuting to work differed significantly (p<0.001), and the population in Sogn & Fjordane were more likely to use active transport (21% vs. 15%) and less likely to use public transport (1.6% vs. 7.3%). Significant differences between the sexes were observed within Sogn & Fjordane, where women had significantly higher education (p=0.015) and lower perceived walkability scores (p=0.007) compared with men.

Built environment correlates of physical activity

Sex-specific associations were found for community perception score (p<0.001 for both physical activity outcomes) and perceived walkability (p=0.038 for MVPA). Living in Sogn & Fjordane, community perception score (for men only), perceived walkability score (for MVPA for women only) and active transport for commuting were associated with overall physical activity and MVPA (all p≤0.004) (Table 2). Adjusted for sociodemographic and health-related factors, the built environment correlates included in the model accounted for 14.8% (R^2=0.148) of the variance in overall physical activity and 15.7%

(R^2=0.157) of the variance in time spent in MVPA. Adding self-efficacy to the model did not change the associations noticeably (data not shown).

Geographic differences in the built environment correlates of physical activity

Geographic-area-specific associations were found for community perception score (p=0.029 for overall physical activity and p=0.045 for MVPA) and public transport for commuting (p=0.027 for MVPA). Community perception score was associated with overall physical activity and MVPA in the rest of Norway (β -24.75, 95%CI: -42.84, -6.67, p=0.007 for overall physical activity and -4.07, 95% CI: -7.24, -0.90, p=0.012 for MVPA) but not in Sogn & Fjordane. Public transport for commuting was associated with MVPA in Sogn & Fjordane (β 12.16, 95% CI: 1.20, 23.12, p=0.03 compared with motorized transportation) but not in the rest of Norway.

Investigating a set of built environment variables and their associations with physical activity established location of residence, community perception score, perceived walkability score and active transport for commuting as correlates for physical activity. However, the effect sizes were small (Table 2). A visual representation of the associations between MVPA and the correlates for Sogn & Fjordane and the rest of Norway is provided in Figure 1a-c. An interaction with location of residence was observed for community perception score (p=0.018) and commuting (p=0.035). The figures indicate that the participants in Sogn & Fjordane who reported the lowest third of the community perception scores had substantially higher MVPA levels compared with those who reported higher community perception scores and compared with the rest of Norway (Figure 1a). Although active transport was associated with higher MVPA compared with motorized transport for commuting for both locations of residence (Figure 1c), public transport was associated with the highest MVPA levels in the rest of Norway, whereas the opposite pattern was observed in Sogn & Fjordane. For perceived walkability score (Figure 1b), the same pattern was observed for both locations of residence: MVPA increased with higher scores. However, the

MVPA levels were higher in Sogn & Fjordane compared with the rest of Norway. The same patterns as for MVPA were observed for overall physical activity (data not shown).

Discussion

The results from this study suggest that overall physical activity and time spent in MVPA are positively associated with living in Sogn & Fjordane, higher perceived walkability scores and active transport for commuting. Higher community perception scores were negatively associated with physical activity among men but not women. Geographic differences in the physical activity correlates were observed, such that community perception score was negatively associated with overall physical activity and MVPA in the rest of Norway, where the majority of the sample lived in municipalities with more than 10,000 inhabitants. However, the association was not found in Sogn & Fjordane, a county where the population was more physically active and where most of the sample lived in municipalities with fewer than 10,000 inhabitants. MVPA was substantial higher among the participants in Sogn & Fjordane who reported the lowest third of community perception scores compared with the rest of Norway. In contrast, public transport for commuting was positively associated with MVPA in Sogn & Fjordane but not in the rest of Norway. Compared with motorized and active transport for commuting, MVPA was highest for those who reported using public transport for commuting in the rest of Norway, whereas it was lowest in Sogn & Fjordane.

Although early findings suggest ambiguous associations between perceived environment and physical activity [5, 26], convincing evidence for a positive association between perceptions of the community and physical activity has been found in more recent European studies [3]. This is contrary to our observations, in which higher community perception scores were associated with lower amounts of physical activity for men in the rest of Norway. Hansen et al. [25] found no association between the same community perception measure and physical activity in a Norwegian population-based sample and argued that the reasonably high mean score not was able to discriminate sufficiently. Our mean scores are equally high; however, the narrow age range in our sample may explain the divergent results for part of the sample. The majority of our study population was employed, which could have influenced this association. Moreover, cultural aspects may have an impact. Throughout Norway, there is easy access to nature and recreation areas near where people live, which could have encouraged physical activity. However, perhaps because the competing availability of activities led to sedentary behavior, a substantial proportion of the population did not appear to use these facilities. In contrast, however, the substantially higher MVPA levels observed in those who reported the lowest community perception scores in Sogn & Fjordane compared with those who reported higher scores and compared with the rest of Norway suggest that correlates other than perceptions of community may influence physical activity. For example, the population in Sogn & Fjordane may choose to be active, or need to be active (for transportation), despite their neighborhood surroundings.

Walkability has been suggested to be positively related to overall physical activity and active transport [3]. A Swedish study [27] found that individuals who lived in highly walkable neighborhoods walked 50 minutes/week more for active transportation and had 3.1 minutes more MVPA/day compared with those who lived in less walkable neighborhoods. Our findings extend this work in that the people who reported higher perceived walkability had higher levels of physical activity in both Sogn & Fjordane and the rest of Norway. As expected, we found a positive association between active transport for commuting and physical activity. This emphasizes the importance of encouraging active transport within communities. The higher proportion of those who used active transport in Sogn & Fjordane compared with the rest of Norway is contrary to previous studies that found a positive association between degree of urbanization and biking for transportation [3]. However, although the population density is low and many people live scattered over a wide area in Sogn & Fjordane, many people live in small urban areas, which enables active transport. The association observed between public transport for commuting and MVPA in Sogn & Fjordane but not in the rest of Norway could possibly be explained by public transport patterns and availability. Compared with more urban areas, the public transport system in Sogn &

Fjordane is poorly developed, which may explain why only 1.6% of the population used public transport for commuting. Furthermore, people who used public transport in Sogn & Fjordane were less physically active compared with those who used motorized transportation, whereas the opposite was observed in the rest of Norway. In Sogn & Fjordane, highly educated people may have to commute to other municipalities for work. Most likely owing to the poorly developed public transport system, these people used motorized transport. Considering the well-established association between education level and leisure time physical activity [2, 28, 29], this may explain the difference in association between public transport and MVPA in Sogn & Fjordane and the rest of Norway. However, when interpreting these results, the small proportion of participants who reported using public transport should be considered.

Even though we cannot categorize Sogn & Fjordane as rural and the rest of Norway as urban, location of residence as a correlate for physical activity may be supported by studies suggesting that people living in less urbanized areas tend to be more physically active [3]. In addition, the presence of hills in a neighborhood and enjoyable scenery have been found to be associated with more activity [30], although a possible negative association has been suggested for biking for transport and hilliness [3]. Community environment, walkability and degree of urbanization have all been suggested as being related to physical activity; however, they have all been shown to be unrelated to recreational physical activity [3]. The county of Sogn & Fjordane has higher levels of physical activity but lower environmental scores compared with the rest of Norway. Except for the fact that a higher proportion of the population in Sogn & Fjordane used active transport for commuting, we do not know if there were any significant differences in the types of physical activity they engaged in. However, there are most likely other explanations for the significantly higher physical activity levels in Sogn & Fjordane that we did not discover.

Our findings confirm previous suggestions that the built environment has a modest yet significant association with physical activity [1-4]. However, the contribution of these potential changes to community participation may be great because favorable modifications to community settings may produce small changes in the behaviors of entire populations. Therefore, identifying environments that produce positive changes in physical activity are important.

Strengths and limitations

Strengths of our study include the use of a large, nationwide, population-based sample within a narrow age range. Additionally, the objective assessment of physical activity provides more detailed information of overall physical activity and time spent in MVPA and is less prone to bias from misreporting or social desirability compared with self-reported physical activity [31, 32].

However, a number of limitations need to be taken into account when interpreting the results. First, with the cross-sectional design, we cannot state any causal relationships based on our data. Furthermore, the response rate might be considered low, which increases the risk for selection bias [33]. However, analyses of the nonresponses for part of the sample found prevalence rates of overweight or obese and other non-communicable diseases similar to other national estimates [25]. Therefore, we believe that the results of this study have a general validity that corresponds to the results from similar studies. The correlates included in our models explained a small proportion of the variance in overall physical activity (14.8%) and MVPA (15.7%). Self-reported exposure variables may be prone to measurement errors, which may attenuate any observed associations [34]. People's perceptions of their environments may be more influenced by their behavior than their actual or objective environments [5, 35]. For walkability, an objective Walk Score [36] can be obtained online; however, the scores are not yet supported in Norway (Jacobson, A., Walk Score, personal e-mail communication). Self-reported measures of built environment customized to Norwegian conditions and culture are also scarce. Because inter-continental differences in the relationship between physical environment and physical activity have been identified [3], the use of scales that were adapted for other countries and continents may have biased our data. For example, questions about traffic lights and safety may be irrelevant for parts of the population, whereas more questions about access to mountain and recreational areas would have been appropriate. Therefore, validated subjective and objective measures of Norwegian built environments are needed in future research. Finally, limitations associated with measuring physical activity by accelerometry should be acknowledged. For example, accelerometry has known limitations in assessing physical activity during specific types of activities, and data reduction challenges do exist [37].

Conclusions

Overall physical activity level and MVPA were partly associated with built environment factors such as location of residence, perceptions of community, walkability and active transport. Geographic differences in the physical activity correlates were observed for community perception and public transport, and thus, locally customized environmental population approaches aimed at increasing physical activity levels may be essential complements to individual behavior and lifestyle strategies.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

AKS participated in the design of the study, drafted the manuscript and performed the statistical analysis and data interpretation. SAA was the lead investigator, participated in the design of the study and contributed to the statistical analysis. IMH, EK and BHH participated in the design of the study and contributed to the statistical analysis. MCA was the senior author, participated in the design of the study and contributed to the statistical analysis. All authors contributed to writing the manuscript, the data interpretation and read and approved the final manuscript.

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References

1. Heath GW, Parra DC, Sarmiento OL, Andersen LB, Owen N, Goenka S, Montes F, Brownson RC, Lancet Physical Activity Series Working G: **Evidence-based intervention in physical activity: lessons from around the world.** *Lancet* 2012, **380:**272-281.
2. Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJ, Martin BW, Lancet Physical Activity Series Working G: **Correlates of physical activity: why are some people physically active and others not?** *Lancet* 2012, **380:**258-271.
3. Van Holle V, Deforche B, Van Cauwenberg J, Goubert L, Maes L, Van de Weghe N, De Bourdeaudhuij I: **Relationship between the physical environment and different domains of physical activity in European adults: a systematic review.** *BMC Public Health* 2012, **12:**807.
4. Hanson HM, Ashe MC, McKay HA, Winters M: **Intersection between the Built and Social Environments and Older Adults' Mobility: An Evidence Review.** *National Collaborating Centre for Environmental Health* 2012.
5. Wendel-Vos W, Droomers M, Kremers S, Brug J, van Lenthe F: **Potential environmental determinants of physical activity in adults: a systematic review.** *Obesity reviews : an official journal of the International Association for the Study of Obesity* 2007, **8:**425-440.
6. Saelens BE, Handy SL: **Built environment correlates of walking: a review.** *Med Sci Sports Exerc* 2008, **40:**S550-566.
7. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT: **Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy.** *Lancet* 2012, **380:**219-229.
8. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, Macera CA, Heath GW, Thompson PD, Bauman A: **Physical Activity and Public Health. Updated Recommendation for Adults From the American College of Sports Medicine and the American Heart Association.** *Journal of the American Heart Association, Circulation* 2007, **116:**1081-1093.

9. Warburton DE, Charlesworth S, Ivey A, Nettlefold L, Bredin SS: **A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults.** *Int J Behav Nutr Phys Act* 2010, **7:**39.

10. Sedentary Behaviour Research Network: **Letter to the editor: standardized use of the terms "sedentary" and "sedentary behaviours".** *Appl Physiol Nutr Metab* 2012, **37:**540-542.

11. Hansen BH, Kolle E, Dyrstad SM, Holme I, Anderssen SA: **Accelerometer-Determined Physical Activity in Adults and Older People.** *Med Sci Sports Exerc* 2012, **44:**266-272.

12. Hagstromer M, Troiano RP, Sjostrom M, Berrigan D: **Levels and patterns of objectively assessed physical activity--a comparison between Sweden and the United States.** *Am J Epidemiol* 2010, **171:**1055-1064.

13. Baptista F, Santos DA, Silva AM, Mota J, Santos R, Vale S, Ferreira JP, Raimundo AM, Moreira H, Sardinha LB: **Prevalence of the Portuguese population attaining sufficient physical activity.** *Med Sci Sports Exerc* 2012, **44:**466-473.

14. Directorate of Health: **Fysisk aktivitetsnivå blant voksne og eldre i Norge - Oppdaterte analyser basert på nye nasjonale anbefalinger i 2014. [Physical activity levels in Adults and Older People in Norway - Updated analyzes based on new national guidelines in 2014].** Oslo: Directorate of Health; 2014.

15. Bjartveit K, Foss OP, Gjervig T, Lund-Larsen PG: **The cardiovascular disease study in Norwegian counties. Background and organization.** *Acta Med Scand Suppl* 1979, **634:**1-70.

16. Solbraa AK, Mamen A, Resaland GK, Steene-Johannessen J, Ylvisåker E, Holme IM, Anderssen SA: **Level of physical activity, cardiorespiratory fitness and cardiovascular disease risk factors in a rural adult population in Sogn og Fjordane.** *Nor J Epidemiol* 2011, **20:**179-188.

17. Graff-Iversen S, Selmer R, Sørensen M, Skurtveit S: **Occupational Physical Activity, Overweight, and Mortality: A Follow-up Study of 47,405 Norwegian Women and Men.** *Research Quarterly for Exercise & Sport* 2007, **78:**151-161.

18. Norwegian Institute of Public Health, 2013. **Folkehelsebarometeret [Public Health Profile]** [http://khp.fhi.no/]. Accessed: 4/1/2014.

19. Wøien G, Øyen O, Graff-Iversen S: **22 years of cardiovascular surveys in Norwegian counties. Is the development in risk factors satisfactory?** *Nor J Epidemiol* 1997, **7:**255-266.

20. Sogn og Fjordane County Council, 2013. **Fylkesspegelen [County statistics]** [http://www.sfj.no/cmssff/cmspublish.nsf/pages/Statistikk_og_analyse]. Accessed: 4/1/2014.

21. Office for National Statistics, 2013. **Population density** [http://www.ons.gov.uk/ons/datasets-and-tables/index.html?pageSize=50&sortBy=none&sortDirection=none&newquery=density]. Accessed: 12/5/2014.

22. Gorman E, Hanson H, Yang P, Khan K, Liu-Ambrose T, Ashe M: **Accelerometry analysis of physical activity and sedentary behavior in older adults: a systematic review and data analysis.** *European Review of Aging and Physical Activity* 2013**:**1-15.

23. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M: **Physical activity in the United States measured by accelerometer.** *Med Sci Sports Exerc* 2008, **40:**181-188.

24. Brownson RC, Baker EA, Housemann RA, Brennan LK, Bacak SJ: **Environmental and policy determinants of physical activity in the United States.** *Am J Public Health* 2001, **91:**1995-2003.

25. Hansen BH, Ommundsen Y, Holme I, Kolle E, Anderssen SA: **Correlates of objectively measured physical activity in adults and older people: a cross-sectional study of population-based sample of adults and older people living in Norway.** *International journal of public health* 2013.

26. Duncan MJ, Spence JC, Mummery WK: **Perceived environment and physical activity: a meta-analysis of selected environmental characteristics.** *Int J Behav Nutr Phys Act* 2005, **2:**11.

27. Sundquist K, Eriksson U, Kawakami N, Skog L, Ohlsson H, Arvidsson D: **Neighborhood walkability, physical activity, and walking behavior: the Swedish Neighborhood and Physical Activity (SNAP) study.** *Soc Sci Med* 2011, **72:**1266-1273.

28. Trost SG, Owen N, Bauman AE, Sallis JF, Brown W: **Correlates of adults' participation in physical activity: review and update.** *Med Sci Sports Exerc* 2002, **34:**1996-2001.

29. Hamer M, Kivimaki M, Steptoe A: **Longitudinal patterns in physical activity and sedentary behaviour from mid-life to early old age: a substudy of the Whitehall II cohort.** *J Epidemiol Community Health* 2012, **66:**1110-1115.

30. King AC, Castro C, Wilcox S, Eyler AA, Sallis JF, Brownson RC: **Personal and environmental factors associated with physical inactivity among different racial-ethnic groups of U.S. middle-aged and older-aged women.** *Health Psychol* 2000, **19:**354-364.

31. Warren JM, Ekelund U, Besson H, Mezzani A, Geladas N, Vanhees L: **Assessment of physical activity - a review of methodologies with reference to epidemiological research: a report of the exercise physiology section of the European Association of Cardiovascular Prevention and Rehabilitation.** *Eur J Cardiovasc Prev Rehabil* 2010, **17:**127-139.

32. Dyrstad SM, Hansen BH, Holme IM, Anderssen SA: **Comparison of Self-reported versus Accelerometer-Measured Physical Activity.** *Med Sci Sports Exerc* 2014, **46:**99-106.

33. Søgaard AJ, Selmer R, Bjertness E, Thelle D: **The Oslo Health Study: The impact of self-selection in a large, population-based survey.** *International Journal For Equity In Health* 2004, **3:**3.

34. Hutcheon JA, Chiolero A, Hanley JA: **Random measurement error and regression dilution bias.** *BMJ* 2010, **340:**c2289.

35. Gebel K, Bauman A, Owen N: **Correlates of non-concordance between perceived and objective measures of walkability.** *Annals of behavioral medicine : a publication of the Society of Behavioral Medicine* 2009, **37:**228-238.

36. Walk Score, 2014. **Walk Score** [http://www.walkscore.com/professional/research.php]. Accessed: 3/18/2014.

37. Matthews CE, Hagstromer M, Pober DM, Bowles HR: **Best practices for using physical activity monitors in population-based research.** *Med Sci Sports Exerc* 2012, **44:**S68-76.

Table 1: Characteristics of the participants*, mean (standard deviation) or proportion (%).

	Sogn & Fjordane				Rest of Norway				
	All (n=487–590)	**Men (n=220–251)**	**Women (n=267–339)**	**p for sex difference**	**All (n=288–382)**	**Men (n=142–175)**	**Women (n=146–207)**	**p for sex difference**	**p for location**†
Overall PA (cpm)	403.8 (148.1)	404.8 (154.8)	402.9 (143.2)	0.878	344.1 (131.9)	339.8 (130.4)	347.7 (133.3)	0.562	**<0.001**
MVPA (min/day)	43.1 (26.5)	44.3 (27.7)	42.2 (25.5)	0.362	34.4 (23.0)	35.4 (22.6)	33.5 (23.4)	0.430	**<0.001**
Sociodemographic									
Age	47.2 (6.5)	47.3 (6.5)	47.1 (6.5)	0.790	46.4 (6.5)	46.7 (6.6)	46.1 (6.5)	0.390	0.067
Education level, n (%)				**0.015**				0.634	**0.012**
Less than high school	44 (7.6)	23 (9.3)	21 (6.3)		35 (9.3)	17 (9.9)	18 (8.7)		
High school	248 (42.6)	119 (48.4)	129 (38.4)		121 (32.0)	60 (34.9)	61 (29.6)		
College or university <4yrs	132 (22.7)	50 (20.3)	82 (24.4)		101 (26.7)	42 (24.4)	59 (28.6)		
College or university ≥4yrs	158 (27.1)	54 (22.0)	104 (31.0)		121 (32.0)	53 (30.8)	68 (33.0)		
Health related									
Height (cm)	173.1 (9.0)	180.6 (7.1)	167.6 (5.6)	**<0.001**	173.6 (8.8)	180.6 (6.1)	167.8 (6.0)	**<0.001**	0.366
Weight (kg)	77.2 (15.0)	86.9 (13.6)	70.0 (11.5)	**<0.001**	77.3 (14.9)	86.9 (12.7)	69.2 (11.5)	**<0.001**	0.922
BMI (kg/m^2)	25.6 (3.9)	26.6 (3.7)	24.9 (3.9)	**<0.001**	25.5 (3.9)	26.6 (3.8)	24.6 (3.7)	**<0.001**	0.627
Overweight	226 (40.6)	119 (50.4)	107 (33.4)		134 (36.8)	81 (48.5)	53 (26.9)		
Obese	67 (12.1)	30 (12.7)	37 (11.6)		42 (11.5)	26 (15.6)	16 (8.1)		
Smoking, n (%)	101 (17.2)	42 (16.8)	59 (17.5)	0.822	74 (19.5)	29 (16.7)	45 (21.8)	0.204	0.371
Perceived health, n (%)				0.546				0.215	0.670
Either	110 (18.7)	51 (20.4)	59 (17.4)		63 (16.5)	33 (18.9)	30 (14.6)		
Good	467 (79.3)	193 (77.2)	274 (80.8)		309 (81.1)	136 (77.7)	173 (84.0)		
Poor	12 (2.0)	6 (2.4)	6 (1.8)		9 (2.4)	6 (3.4)	3 (1.5)		
Built environment									
Size of home municipality, n (%)				0.210				0.637	**<0.001**
≤10,000	564 (99.3)	248 (100)	316 (98.8)		54 (14.6)	22 (12.8)	32 (16.2)		
10,001–30,000	2 (0.4)	-	2 (0.6)		135 (36.6)	65 (37.8)	70 (35.5)		
≥ 30,001	2 (0.4)	-	2 (0.6)		180 (48.8)	85 (49.4)	95 (48.2)		
Perceived community score	3.1 (0.7)	3.1 (0.7)	3.1 (0.7)	0.978	3.4 (0.6)	3.4 (0.5)	3.3 (0.7)	0.418	**<0.001**
Perceived walkability score	3.3 (0.7)	3.4 (0.7)	3.3 (0.7)	**0.007**	3.4 (0.7)	3.5 (0.7)	3.4 (0.7)	0.170	0.142

Commuting, n (%)				0.130				0.058	**<0.001**
Motorized transport	378 (77.6)	180 (81,8)	198 (74.2)		223 (77.4)	114 (80.3)	109 (74.7)		
Public transport	8 (1.6)	3 (1.4)	5 (1.9)		21 (7.3)	13 (9.2)	8 (5.5)		
Active transport	101 (20.7)	37 (16.8)	64 (24.0)		44 (15.3)	15 (10.6)	29 (19.9)		

*the number of participants varies between each variable

†Sogn & Fjordane vs. the rest of Norway

cpm, counts per minute per day; MVPA, moderate-to-vigorous physical activity; BMI, body mass index

Table 2. Built environment correlates of overall physical activity (cpm) and MVPA (min/day), n=886.

	Overall physical activity (cpm)				**MVPA (min/day)**			
	β	**p-value**	**95% CI**	**R^2**	**β**	**p-value**	**95% CI**	**R^2**
				0.148				0.157
S&Fj vs. rest of Norway	53.99	**0.002**	(19.34, 88.64)		8.86	**0.004**	(2.79, 14.93)	
Size of home municipality								
≤10,000	Ref				Ref			
10,001–30,000	-16.53	0.421	(-56.78, 23.73)		-1.68	0.640	(-8.73, 5.38)	
≥ 30,001	14.74	0.463	(-24.68, 54.15)		3.70	0.294	(-3.21, 10.60)	
Perceived community	-13.22	0.081	(-28.07, 1.64)		-2.20	0.098	(-4.80, 0.40)	
Men	-48.94	**<0.001**	(-70.99, -26.90)		-8.71	**<0.001**	(-12.57, -4.85)	
Women	9.37	0.308	(-8.66, 27.40)		1.92	0.223	(-1.24, 5.07)	
Perceived walkability	28.52	**<0.001**	(14.97, 42.07)		4.90	**<0.001**	(2.52, 7.27)	
Men	---	---	---		2.42	0.154	(-0.913, 5.75)	
Women	---	---	---		7.00	**<0.001**	(3.91, 10.09)	
Commuting								
Motorized transport	Ref				Ref			
Public transport	-2.14	0.937	(-55.23, 50.95)		5.57	0.240	(-3.73, 14.87)	
Active transport	39.57	**0.002**	(14.12, 65.02)		7.61	**0.001**	(3.15, 12.07)	

All associations are adjusted for sex, BMI, education level, smoking, perceived health and mean daily wear time.
cpm, counts per minutes; MVPA, moderate-to-vigorous physical activity; BMI, body mass index

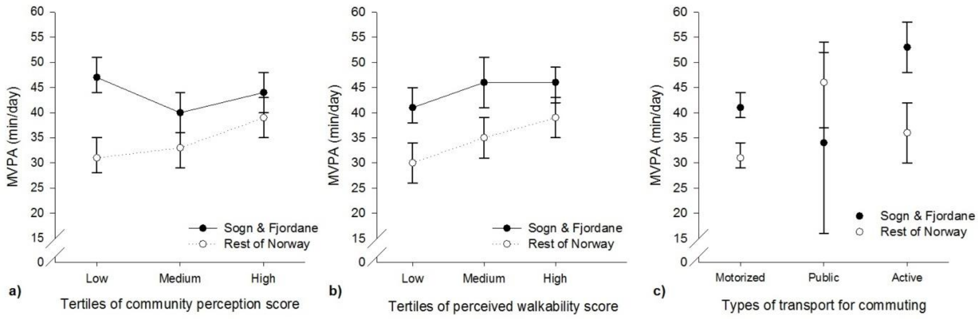

Figure 1a-c: Associations between moderate-to-vigorous physical activity (MVPA) (min/day) and **a)** community perception score, **b)** perceived walkability score and **c)** types of transport for commuting, by location of residence. All associations are adjusted for sex, BMI, education level, smoking, perceived health and mean daily wear time.

Appendix I:

Approval letters from the Regional Committees for Medical Research Ethics

Approval letter from the Norwegian Social Science Data Services

Approval letters from the Norwegian Institute of Public Health

Approval letters from the Norwegian Tax Department

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Dato: 11.02.08
Deres ref.:
Vår ref.: S-08046b

S-08046b Kartlegging av fysisk aktivitetsnivå, helserelatert fysisk form og determinanter for fysisk aktivitet hos voksne og eldre i Norge [6.2008.142]

Søknad mottatt 08.01.08 med følgende vedlegg: Protokoll; informasjonsskriv med samtykkeerklæring; spørreskjema; følgebrev til REK Sør-Øst datert 7. januar 2008.

Komiteen behandlet søknaden i sitt møte den 31. januar 2008. Prosjektet er vurdert etter lov om behandling av etikk og redelighet i forskning av 30. juni 2006, jfr. Kunnskapsdepartementets forskrift av 8. juni 2007 og retningslinjer av 27. juni 2007 for de regionale komiteer for medisinsk og helsefaglig forskningsetikk.

Forskningsetisk vurdering
Denne studien er todelt, og vil kartlegge status for fysisk aktivitetsnivå, determinanter for fysisk aktivitet, fysisk form og variabler relatert til fysisk form blant den voksne og eldre delen av den norske befolkningen. Komiteen ser ingen etiske betenkeligheter ved denne studien, forutsatt at den direkte målingen av fysisk form/aerob kapasitet i undersøkelsens Del 2 gjennomføres slik den er beskrevet i prosjektbeskrivelsen (dvs. at screening foretas før testen og at akuttmedisinsk hjelp er tilgjengelig under testen).

Vi ber imidlertid prosjektgruppen om å revurdere utvalgsstørrelsen som ligger til grunn for undersøkelsens Del 1. Styrkeberegningene som ligger til grunn for Del 1 (og for Del 2) synes å hvile på et solid grunnlag. Vi ser imidlertid at prosjektgruppen forventer at hele 2/3 deler av de 6000 personene som blir forespurt sier seg villige til å delta i del 1 av studien. Dette synes svært optimistisk med utgangspunkt i at prosjektgruppen henviser til at responsraten ved nylig gjennomførte landsdekkende undersøkelser i regi av FHI har vært på om lag 50 %. Det at deltagerne bes om å bære et akselerometer i en periode på syv dager vil nok neppe bidra til å øke responsraten. Komiteen ønsker en refleksjon omkring hvorvidt dette er realistisk.

I prosjektets Del 2 foreslås det å utelate aldersgruppen 20-30 år pga. økonomiske hensyn. Et av prosjektets mer langsiktige målsetninger er å studere utviklingstrender innen ulike aldersgrupper, gjennom å gjenta undersøkelsen med jevne mellomrom. At den yngste aldersgruppen utelates er bekymringsfullt da dette vil gjøre det problematisk å studere endringer i de yngste aldergruppene over tid. Siden potensialet for forebygging sannsynligvis er størst i nettopp de yngste aldersgruppene, vil utelatelsen redusere undersøkelsens verdi som redskap for forebygging. Vi ber prosjektgruppen om å vurdere på nytt om ikke også denne aldersgruppen bør inkluderes.

Informasjonsskriv/samtykkeerklæring
1. Informasjonsskrivet må påføres logo.
2. I andre avsnitt på første side må det informeres at testen av fysisk form kan påføre enkelte noe ubehag da deler av denne skal utføres under høy intensitet (flytt dette fram fra kapittel A).

3. Det må opplyses om at prosjektet er godkjent av Regional komité for medisinsk og helsefaglig forskningsetikk Helseregion Sør avdeling B, REK Sør B.
4. I kapittel A og B kan begrepsbruken være litt vanskelig å forstå. "Akselerometer" foreslås byttet ut med "aktivitetsmåler". Videre bør det forklares hva som ligger i at "eventuell utgifter for deltakerne i undersøkelsens del 2 vil bli dekket".
5. Dato for sletting av data/kode må angis.
6. "Dette vil ikke få konsekvenser for din videre må behandling" må utgå da personene som deltar i dette prosjektet ikke er til behandling som er knyttet til deltakelsen.

Vedtak
Prosjektet godkjennes under forutsetning av at de merknadene som er anført ovenfor blir innarbeidet før prosjektet settes i gang. Revidert informasjonsskriv og samtykkeerklæring må sendes komiteen til orientering.

Komiteens avgjørelse var enstemmig.

Komiteens vedtak kan påklages (jfr. Forvaltningslovens § 28) til Den nasjonale forskningsetiske komité for medisin og helsefag. Klagen skal sendes til REK Sør-Øst B (jfr. Forvaltingslovens § 32). Klagefristen er tre uker fra den dagen du mottar dette brevet (jfr. Forvaltningslovens § 29). Det bes presisert hvilke vedtak/vilkår som påklages og den eller de endringer som ønskes. Se informasjon om klageadgang og partsinnsynsrett på http://www.etikkom.no/REK/klage

Med vennlig hilsen

Tor Norseth
Leder

Jorunn Lindholt
Jorunn Lindholt
Sekretær

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Dato: 08.07.08
Deres ref.:
Vår ref.: S-08046b

S-08046b Kartlegging av fysisk aktivitetsnivå, helserelatert fysisk form og determinanter for fysisk aktivitet hos voksne og eldre i Norge [6.2008.142]

Vi viser til skjema for protokolltillegg og endringer datert 12.06.08 vedlagt revidert informasjonsskriv.

Endringene innebærer å be enkelte deltakere om samtykke til å koble informasjon fra kartleggingsprosjektet med data som er tilgjengelig fra tidligere screeningundersøkelser. Endringen gjelder Sogn og Fjordane og Oslo.

Komiteen har ingen innvendinger mot de foreslåtte endringene i studien.

Vi ønsker lykke til videre med prosjektet.

Med vennlig hilsen

Tor Norseth (sign.)
Leder

Julianne Krohn-Hansen
Sekretær

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Dato: 11.06.2010
Deres ref.:
Vår ref.: 2010/1274 (oppgis ved henvendelse)

2010/1274b Kan1- Tilleggsundersøkelser
Prosjektleder: Sigmund Alfred Anderssen
Forskningsansvarlig: Ane Krisitansen Solbraa oppført, men bør vel være NIH

Saksfremstilling
Personer som deltar i prosjektet Kan1-fase 2 vil bli bedt om å avgi blodprøve for analyse av CRP samt delta i en begrenset helseundersøkelse som består av en fysisk undersøkelse og svar på noen få spørsmål om helse. Videre blir de bedt om tillatelse til at disse opplysningene kan kobles til resultatene fra en screeningundersøkelse om helse som blant annet ble foretatt hos de samme individene i Sogn og Fjordane i 1995-96.

Kan1-studien ble godkjent av REK i 2008. Formålet med biobanken er å få kartlagt risikofaktorer for hjerte- og karsykdommer ved analyse av "Blodprøver – serum skal lagres og fryses for samlet analysering av CRP". Dette skal fysisk skje på Oslo universitetssykehus, Ullevål, og et fåtall forskere vil ha tilgang til forskningsbiobanken. De personer som ønsker det, vil få tilbakemelding på blodprøvene, og prøvene vil bli tatt av godkjent helsepersonell. Det heter videre at blodprøvesvarene vil bli anonymisert ved videre analyse i forskningssammenheng.

Forskningsetisk vurdering
Det er sendt inn søknad om opprettelse av generell forskningsbiobank, men komiteen oppfatter at det søkes om opprettelse av spesifikk forskningsbiobank til Kan1-studien som en utvidelse av tidligere godkjent søknad S-08046b. Komiteen ser ingen etiske betenkeligheter med opprettelsen av forskningsbiobanken.

Prosjektleder har i e-post av 02.06.10 klargjort at det blir analysert for total kolesterol, HDL-kolesterol, triglyserdier samt blodglukose. I svarene fra Ullevål sykehus angis et referanseområde hvor disse prøvesvarene normalt skal være. Der hvor prøvesvar er utenfor referanseområdet tas det kontakt med deltaker og vedkommende bes ta kontakt med sin fastlege for eventuell oppfølging. Disse blodparametre analyseres for øvrig fortløpende. Dette materialet inngår derfor ikke i den omsøkte forskningsbiobanken, da materialet skal destrueres rett etter analyse.

Forskningsbiobanken gjelder blodprøver hvor det skal gjøres analyse for CRP - en generell markør for inflammasjon. Det er anbefalt at analysen av denne skjer samtidig på hele datamaterialet og derfor fryses blod ned. Når datainnsamlingen er ferdig, og det er analysert for CRP, destrueres blodet. Det er ikke lagt opp til tilbakemelding på denne markøren fordi prøvene analyseres noen måneder etter at blodprøven er tatt, og den har da neppe noen klinisk betydning.

Informasjonsskriv/samtykkeerklæring
Informasjonsskriv for KAN1, fase 2 og egenerklæring for fase 2 ble ikke innsendt sammen med søknaden om opprettelse av forskningsbiobank. Disse er ettersendt via e-post av Ane Solbraa.

Det foreligger ingen informasjon om forskningsbiobanken. Deltakerne skal ha standard informasjon om forskningsbiobanken; ansvarshavende, formål og varighet, eventuelt også informasjon om utsending av materialet til utlandet. Se for øvrig mal for informasjonsskriv på våre hjemmesider, http://helseforskning.etikkom.no.

Vedtak
Komiteen har vurdert søknad om opprettelse av spesifikk forskningsbiobank og godkjenner denne i henhold til helseforskningsloven § 25. Godkjennelsen gis under forutsetning av at informasjonsskrivet for Kan1, fase 2 gir nødvendig informasjon om forskningsbiobanken. Revidert informasjonsskriv bes sendt til komiteen *til orientering.*

- Forskningsbiobankens ansvarshavende er professor Sigmund Alfred Anderssen.
- Forskningsbiobankens navn er " Kan1- Tilleggsundersøkelser"
- Biobankens varighet er ikke oppgitt, men er satt til 2020.
- Helseopplysninger som er avidentifiserte eller pseudonyme kan overføres til land utenfor EØS under forutsetning av at kopling til personidentifikasjoner ikke kan skje så lenge opplysningene befinner seg i vedkommende land.

Melding om godkjenningen er sendt til Biobankregisteret.

Komiteen gjør oppmerksom på at REK må søkes om tillatelse til opphør, nedleggelse eller overtakelse av forskningsbiobank jf. helseforskningsloven § 30.

Forskningsprosjektets data skal oppbevares forsvarlig, se personopplysningsforskriften kapittel 2, og Helsedirektoratets veileder for «Personvern og informasjonssikkerhet i forskningsprosjekter innenfor helse- og omsorgssektoren», http://www.norsk-helsenett.no/informasjonssikkerhet/bransjenormen/Personvern%20og%20informasjonssikkerhet%20i%20forskningsprosjekter%20v1.pdf

Tillatelsen gjelder til 31.12.2020. Av dokumentasjonshensyn skal opplysningene bevares til 31.12.2025. Opplysningene skal lagres avidentifisert i en nøkkel- og en opplysningsfil. De skal deretter anonymiseres eller slettes.

Prosjektet skal sende sluttmelding til REK sør-øst B, se helseforskningsloven § 12, senest et halvt år etter tidligere oppgitt dato for prosjektavslutning.

Komiteens vedtak kan påklages til Den nasjonale forskningsetiske komité for medisin og helsefag, jf. forvaltningsloven 28 flg. En eventuell klage sendes til REK sør-øst B. Klagefristen er tre uker fra mottak av dette brevet.

Komiteens avgjørelse var enstemmig.

Med vennlig hilsen

Stein Opjordsmoen Ilner (sign.)
leder

Julianne Krohn-Hansen
seniorrådgiver

Kopi: NIH, Avdeling for forskningsforvaltning og dokumentasjon, postboks 4014 Ullevål stadion, 0806 Oslo
Biobankregisteret v/ nina.hovland@fhi.no

UNIVERSITETET I OSLO
DET MEDISINSKE FAKULTET

Professor Dr. scient Sigmund Alfred Anderssen
Norges idrettshøgskole
Pb. 4014 Ullevål Stadion
0806 Oslo

Regional komité for medisinsk og helsefaglig forskningsetikk Sør-Øst B (REK Sør-Øst B)
Postboks 1130 Blindern
NO-0318 Oslo

Telefon: 22 85 06 70
Telefaks: 22 85 05 90
E-post: katrine.ore@medisin.uio.no
Nettadresse: www.etikkom.no

Dato: 07.02.2011
Deres ref.:
Vår ref.: 2010/1797

Prosjektet har fått nytt saksnummer 2010/1797 som en følge av at REK har fått nytt saksbehnadlingssystem.

S-08046b Kartlegging av fysisk aktivitetsnivå, helserelatert fysisk form og determinanter for fysisk aktivitet hos voksne og eldre i Norge [6.2008.142]

Vi viser til skjema for prosjektendring mottatt 14.12.2010. Det er sendt inn følgende vedlegg:

1. Samtykke Kan1 fase 1.
2. Invitasjon Kan1 fase 2.
3. Samtykke og egenerklæring Kan1 fase 2.pdf - Vedlegg 3 Samtykke og egenerklæring Kan1 fase2
4. Informasjon og reservasjon av kopling - Ny forespørsel om deltakelse.

I endringsmedlingen anføres følgende endringer som søkes godkjent:

”Kan1-prosjektet ble gjennomført i 2008-2010 og hadde til hensikt å kartlegge fysisk aktivitetsnivå og determinanter for fysisk aktivitet (fase 1 av studien) og helserelatert fysisk form (fase 2 av studien). I Sogn og Fjordane ble blant annet et tilleggsutvalg på alle kvinner og menn i kommunene Luster, Sogndal og Leikanger født i 1954-56 inkludert i studien (N=543). Statens helseundersøkelser (SHUS) har tidligere gjennomført en rekke undersøkelser i Sogn og Fjordane, der blant annet det nevnte utvalget har vært inkludert. For å få kjennskap til endringer i helsevaner og risikofaktorer for hjerte- og karsykdom over tid er det ønskelig å koble data fra de nevnte undersøkelsene. Denne koblingen har tidligere blitt godkjent av REK (godkjent 08.07.08). I informasjonskrivet/samtykket til fase 1 av Kan1-undersøkelsen står det at: ”Det kan bli aktuelt å hente inn opplysningar om deg frå nasjonale helseregister: Skade-, kreft-, dødsårsaks- og reseptregisteret. ”Vi ber om løyve frå deg til å hente inn tilleggsinformasjonen frå desse registra.” (se vedlegg 1). Da vi skulle søke Folkehelseinstituttet (FHI) om tilgang på data fra SHUS i Sogn og Fjordane fikk vi melding om at presiseringen av nasjonale helseregistre over ikke dekket denne undersøkelsen. Ved gjennomføring av fase 2 i Kan1-studien ble ca 25% av utvalget fra fase 1 inkludert. I informasjonsbrevet og samtykke fra fase 2 (se vedlegg 2 og 3) ble koblingen til tidligere helseundersøkelser i Sogn og Fjordane presisert og spurt om samtykke til. Av de 111 som deltok i fase 2 fra det aktuelle utvalget, samtykket 108 til denne koblingen. De tre som ikke samtykket bodde ikke i Sogn og Fjordane på det aktuelle tidspunktet undersøkelsen fant sted. I etterkant av innhentingen av dette samtykket ser vi at det hadde vært ønskelig å be alle de 543 som var invitert i Kan1 fra det nevnte utvalget om samtykket til å koble data samlet inn gjennom tidligere helseundersøkelser. Dette for å kunne beskrive seleksjonen til deltakelse i Kan1, for å kunne koble tidligere innsamlet opplysninger til data fra både fase 1 og 2 i Kan1 og for å få bedre styrke i analysene. Dette er også ønskelig fra FHI sin side, og med bakgrunn i en oppfordring fra FHI og den høye oppslutningen blant de som allerede er spurt om samtykke, ber vi om å få benytte oss av passivt samtykke med mulighet for å reservere seg mot kobling av opplysninger. I tillegg til dette ønsker muligheten til å koble data om de inviterte til Kan1 til nasjonale helseregistre som dødsårsaks-, kreftregisteret og andre. Dette for å kunne undersøke sammenhenger mellom helsevaner, helserelatert fysisk form, risikofaktorer for hjerte- og karsykdom og helseutfall. Også her er det viktig å undersøke seleksjon til deltakelse i Kan1. Vedlagt ligger utkast til informasjonsbrev og reservasjonsskjema (vedlegg 4)."

Forskningsetisk vurdering
I endringsmeldingen søkes det om tillatelse til å koble prosjektdata til flere helseregistre og at registerkoblingen skal baseres på en dispensasjon fra å innhente samtykke fra de registrerte men med informasjon til de registrerte som kan reservere seg fra at opplysninger om dem kan benyttes i prosjektets registerkoblinger. Komiteen har vurdert endringsmeldingen i forhold til prosjektets formål og gir tillatelse til prosjektets registerkoblinger. Fordi det skal sammenstilles (kobles) opplysninger fra forskriftsregulerte helseregistre med opplysninger som er samlet inn i forskningsprosjektet, så kreves det forhåndsgodkjenning og dispensasjon fra taushetsplikten fra REK i henhold til helseforskningsloven § 33 jf § 9 for å kunne gjennomføre denne sammenstillingen og gi prosjektet det nødvendige behandlingsgrunnlaget for behandling av personopplysninger.

Komiteen har vurdert endringssøknaden og har ingen øvrige forskningsetiske innvendinger mot endringen av prosjektet. Komiteen godkjenner prosjektet slik det nå foreligger med hjemmel i helseforskningsloven § 11.

Tillatelsen er gitt under forutsetning av at prosjektet gjennomføres slik det er beskrevet i søknad samt endringsmelding og protokollen, og de bestemmelser som følger av helseforskningsloven med forskrifter.

Forskningsprosjektets data skal oppbevares forsvarlig, se personopplysningsforskriftens kap. 2, og Helsedirektoratets veileder for "Personvern og informasjonssikkerhet i forskningsprosjekter innenfor helse- og omsorgssektoren"
(http://www.helsedirektoratet.no/samspill/informasjonssikkerhet/norm_for_informasjonssikkerhet_i_helsesektoren_232354)

Vi minner om at prosjektet skal sende sluttmelding på eget skjema senest et halvt år etter prosjektslutt jfr helseforskningsloven § 12.

Med vennlig hilsen

Stein Opjordsmoen Ilner (sign.)
Professor dr. med
Komitéleder

Katrine Ore
Komitésekretær/Rådgiver

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

Harald Hårfagres gate 29
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
Fax: +47-55 58 96 50
nsd@nsd.uib.no
www.nsd.uib.no
Org.nr. 985 321 884

Sigmund A. Anderssen
Seksjon for idrettsmedisinske fag
Norges idrettshøgskole
Postboks 4014 Ullevål Stadion
0806 OSLO

Vår dato: 24.04.2008 Vår ref: 18886 / 2 / SF Deres dato: Deres ref:

TILRÅDING AV BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 14.03.2008. Meldingen gjelder prosjektet:

18886	*Kartlegging av fysisk aktivitetsnivå, helserelatert fysisk form og determinanter for fysisk aktivitet hos voksne og eldre i Norge*
Behandlingsansvarlig	*Norges idrettshøgskole, ved institusjonens øverste leder*
Daglig ansvarlig	*Sigmund A. Anderssen*

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/forsk_stud/skjema.html. 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/prosjektoversikt.jsp.

Personvernombudet vil ved prosjektets avslutning, 31.12.2020, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Bjørn Henrichsen   Sølve Fauskevåg

Kontaktperson: Sølve Fauskevåg tlf: 55 58 25 83
Vedlegg: Prosjektvurdering

Personvernombudet for forskning

Prosjektvurdering - Kommentar

18886

BAKGRUNN
Prosjektet er et samarbeid mellom institusjonene:
- Norges idrettshøgskole
- Høgskolene i Finnmark, Bodø, Sogn og Fjordane, Vestfold, Telemark og Hedmark
- Universitetene i Stavanger og Agder, samt NTNU

Norges idrettshøgskole (NIH) er koordinerende aktør og databehandlingsansvarlig for prosjektet. Prosjektleder, ved NIH, er daglig ansvarlig. Det inngås databehandleravtaler mellom samarbeidspartene i henhold til personopplysningsloven § 15.

FORMÅL
Formålet med undersøkelsen er å øke kunnskapen om fysisk aktivitetsnivå, fysiske aktivitetsvaner, samt determinanter for fysisk aktivitet i den voksne delen av den norske befolkningen.

Undersøkelsen iverksettes på initiativ fra Sosial- og helsedirektoratet. Det kan bli aktuelt å gjennomføre oppfølgingsundersøkelser om fem og/eller ti år, og det kan være aktuelt å utvide datagrunnlaget med registerdata. Eventuelle nye oppfølginger og/eller utvidelser meldes ombudet i god tid før iverksetting.

UTVALG, INFORMASJON OG SAMTYKKE
Utvalget er et tilfeldig utvalg av cirka 8000 personer. Utvalget trekkes fra Folkeregisteret og av EDB Business Partner basert på tillatelse fra Skattedirektoratet.

Utvalget sendes informasjonsskriv og kan samtykke skriftlig til deltakelse.

DATAMATERIALET
Datamaterialet innhentes ved hjelp av spørreskjema, aktivitetsmåler og fysiske tester og målinger. Datamaterialet inneholder blant annet navn, personnummer, kjønn, alder, etnisk bakgrunn, yrke, inntekt og utdanningsnivå, kommune, røyking og snus, medlemskap i idrettslag/foreninger, kosthold og bruk av TV og PC, fysisk form (balanse, styrke, bevegelighet og koordinasjon), høyde, vekt, livvidde, hoftevidde, kroppssammensetning, blodtrykk samt resultatene fra aktivitetsmåler (akselerometer) som utvalget skal gå med i syv dager.

REGISTRERING, OPPBEVARING OG UTLEVERING
Navn, fødselsår, adresse, fødekommune og fødeland, sivilstatus og antall barn trekkes fra Folkeregisteret. Informasjonsskriv sendes det trekte utvalget. Det kan gjøres en purring til personer som ikke har svart på første forespørsel.

Alle registrerte opplysninger tilknyttet den delen av utvalget som ikke samtykker, anonymiseres umiddelbart etter at svarfristen på purringen har utløpt.

Prosjektleder vil ha tilgang til hele datamaterialet. De lokale koordinatorene har tilgang til den delen av datamaterialet som de er ansvarlige for å samle inn. Prosjektets styringsgruppe vil ikke ha tilgang til datamaterialet.

Prosjektet forventes avsluttet med rapport 31.01.2009. Datamaterialet skal deretter oppbevares til 31.12.2020 med tanke på eventuelle oppfølgings- eller utvidede undersøkelser. Innen 31.12.2020 anonymiseres datamaterialet. Anonymisering innebærer at direkte og indirekte personidentifiserende opplysninger slettes eller omskrives (grovkategoriseres), samt at koblingsnøkkel slettes.

ANDRE TILLATELSER
Prosjektet er godkjent av Regional komité for medisinsk forskningsetikk Midt-Norge (REKs ref. S-08046b).

Skatteetaten har gitt tillatelse til å trekke utvalget inkludert noen bakgrunnsopplysninger fra Folkeregisteret (Skatteetatens ref. 2008/167522 /SKDRESF/GTE /341).

KOMMENTAR
Personvernombudet finner at prosjektet kan gjennomføres med hjemmel i personopplysningsloven (pol) §§ 8, første ledd og 9 a), samtykke.

Informasjonsskrivet per 23.04.2008 er godt utformet og redegjør for alle sider ved prosjektet forutsatt at dato for anonymisering av data tilføyes, jf. e-post samme dag.

Trekking og førstegangskontakt med utvalget kan hjemles i personopplysningsloven §§ 8 d) og 9 h). Det vises til at undersøkelsen er på oppdrag fra Sosial- og helsedirektoratet og tar sikte på å fremskaffe ny representativ kunnskap om aktivitet og helse. Trekking og kontakt med et representativt utvalg kan vanskelig gjøres på mer skånsom måte enn via Folkeregisteret. Ulempene for de registrerte er minimale da de informeres om trekkingen, og registrerte opplysninger anonymiseres umiddelbart for de som ikke samtykker innen svarfrist for purringen har utløpt.

folkehelseinstituttet

KONTRAKT

mellom Nasjonalt Folkehelseinstitutt og Sigmund Andersen ved Norges Idrettshøgskole om utlevering av data fra 40-åringsundersøkelsene i Sogn og Fjordane i 1996

Arkivnr. FHI: 10/1037	Prosjektdatabasenr. 835

PROSJEKTTITTEL

Fysisk aktivitetsnivå, fysisk form og risikofaktorer for hjerte- og karsykdommer i Sogn og Fjordane

PROSJEKTLEDER

Arbeidssted:	**Norges Idrettshøgskole**
Stilling og navn:	Sigmund Alfred Anderssen
Avdeling:	Seksjon for idrettsmedisinske fag (SIM)
Adresse:	Pb 4014 Ullevål stadion, 0806 OSLO
Telefon:	23262301
E-post:	sigmund.anderssen @nih.no

MEDARBEIDERE

Med datatilgang:
Ane K. Solbraa, Stipendiat, NIH, SIM / Høgskulen i Sogn og Fjordane (HSF), Avdeling for lærarutdanning og idrett (ALI)
Ingar Holme, NIH/Ullevål Sykehus
Sidsel Graff-Iversen, Folkehelseinstituttet

Uten datatilgang:
Jostein Steene-Johannessen, HSF
Geir Kåre Resaland, HSF

TIL HVILKET FORMÅL OPPLYSNINGENE UTLEVERES/ PROBLEMSTILLING(ER)

Hensikten med studien er å undersøke fysisk aktivitetsnivå, fysisk form, risikofaktorer for hjerte- og karsykdommer, samt sekulære trender i Sogn og Fjordane. En ønsker å sammenligne verdier av risikofaktorer for hjerte- og karsykdommer for 40-42 åringer målt med 14 års mellomrom, få individuelle data på utviklingen av risikofaktorer for hjerte- og karsykdommer over tid og relatere dem til objektive data om fysisk aktivitet.

KONTRAKTSPERIODE

Kontraktperioden er: 13.10.2010 til 31.10.2014 Det kan søkes om forlengelse av perioden.
INNHOLDET I FORSKNINGSFILEN
Data fra 40-åringsundersøkelsen i Sogn og Fjordane i 1996, med følgende variabler: Alle underspørsmål fra spørreskjema på temaene egen helse, endring av helsevaner, røyking og mosjon. I tillegg blodtrykk, høyde, vekt, totalkolesterol, HDL-kolesterol, triglyserid og glucose. Dersom prosjektleder får godkjent endringsmelding til REK i ettertid, vil rest-spørsmålene fra spørreskjema bli utlevert: Sykdom i familien, kaffe/te/alkohol, fett og utdanning.
HJEMMELSGRUNNLAG FOR UTLEVERING OG KOBLING
Behandlingsgrunnlaget til 40-årsundersøkelsen i Sogn og Fjordane i 1996, er hjemlet i "Hovedkonsesjon for landsomfattende helseundersøkelser" av 13.10.2003 (2003/111-12), forlenget i brev av 28.1.2010 (ref. 03/00111-43) til 31.12.2011. Behandlingsgrunnlaget til dette prosjektet, "Fysisk aktivitetsnivå, fysisk form og risikofaktorer for hjerte- og karsykdommer i Sogn og Fjordane", faller inn under konsesjon for hovedprosjektet "Kartlegging av fysisk aktivitetsnivå og fysisk form i et landsrepresentativt utvalg voksne og eldre".
MOTTAKER FORPLIKTER SEG TIL Å OVERHOLDE FØLGENDE VILKÅR
• Mottaker kan ikke kople filen på nytt utover koblingen til egeninnsamlete data, slik det er beskrevet i søknaden til FHI av 26.3.2010. Opplysningene skal kun brukes til det formålet som er oppgitt og skal ikke overlates til andre forskere eller institusjoner uten at disse er oppført under "medarbeidere" eller har egen tillatelse. • *Oppbevaring:* Opplysningene skal oppbevares betryggende og på en slik måte at uvedkommende ikke får tilgang til dem. Det henvises til institusjonens sikkerhetsrutiner som forutsettes er i samsvar med norsk lov. • *Publisering og annen offentliggjøring* skal gis i en slik form at enkeltpersoner ikke kan identifiseres. Bakveisidentifisering eller forsøk på rekonstruksjon av identitet på utlevert materiale er ikke tillatt. • *Sletting*: Midlertidig utlevering av datamateriale er vurdert i forhold til at ett bestemt formål er overensstemmende med registerets/helseundersøkelsens formål. Etter at kontraktperioden er avsluttet, skal data slettes. Dette gjelder også kopier av materialet og eventuelle avidentifiserte versjoner. Anonymisering er ikke tilstrekkelig. **Frist for sletting av data er 31.10.2014** Skriftlig bekreftelse på at materialet er blitt slettet skal oversendes Nasjonalt folkehelseinstitutt v/avdeling for forskningsdata (ILPS). Skjema for sletting av data vil bli tilsendt prosjektleder. • *Publisering av artikler:* Faglig ansvarlig for 40-åringsundersøkelsen, Sidsel Graff-Iversen ved FHI, skal holdes orientert om prosjektets gang ved oversendelse av abstracts (aksepterte) og vitenskapelige arbeider **før** publisering. Faglig ansvarlig skal gi tilbakemelding på mottatte manuskripter <u>innen to uker</u> etter at artikkelen er bekreftet mottatt. Hvis ikke mottaker får tilbakemelding innen to uker, kan arbeidet sendes til publisering. Ved publisering skal

forfatter følge Vancouver-reglene. Søker forplikter seg ved publisering av resultater til enhver tid å oppgi følgende: 1) Hvilke institusjoner som har samlet inn de aktuelle data. 2) Hvilke institusjoner som formelt er eiere av materialet.

- Folkehelseinstituttet har ikke ansvar for innhold i publikasjoner, analyser eller konklusjoner basert på de utleverte data.
- For øvrig gjelder vilkår i " R102 Utlevering av data til forskning fra konsesjonsbelagte helseundersøkelser, forskningsfiler og andre registre."
- Resultater av analyser av data fra 40-åringsundersøkelsen i Sogn og Fjordane i 1996 kan ikke bli brukt for kommersielle formål.

KOSTNADER

Til oppdraget (saksbehandlertid og preparering og ferdigstilling av datafiler) er det medgått 8 timer á kr. 815,- ekskl. mva, totalt kr. 6520,- ekskl. mva. Egen faktura vil bli sendt.

Sted/dato Oslo 13/10-2010

Sigmund A. Anderssen
Prosjektleder

Sted/dato Oslo 13.10.2010

Wenche Nystad
Avdelingsdirektør, FHI

Norwegian Institute of Public Health

KONTRAKTSVEDLEGG

Denne kontrakten er et vedlegg til eksisterende og bindende kontrakt mellom Nasjonalt folkehelseinstitutt (FHI) og Idrettshøgskolen ved Sigmund Anderssen
Dette er et vedlegg til kontrakt signert 13.10.2010

Arkivnummer FHI: 10/1037	**Prosjektdatabasenummer: 835**

PROSJEKTTITTEL

Fysisk aktivitetsnivå, fysisk form og risikofaktorer for hjerte- og karsykdommer i Sogn og Fjordane

PROSJEKTLEDER

Prosjektleder:	Sigmund Anderssen
E-post:	sigmund.anderssen@nih.no

NYE MEDARBEIDERE

Med datatilgang: ingen nye medarbeidere

NYE PROBLEMSTILLINGER, NYE VARIABLER

Utvidelsen vil innebære å innlemme alle de syv SHUS undersøkelsene i Sogn og Fjordane (1975, -80, -85, -90, -93, -96 og -99) for å se på sekulære trender over en periode på 35 år, samt å få tilgang til de nasjonale tallene fra samme periode for å kunne se på forskjeller mellom Sogn og Fjordane og resten av landet i hele perioden.

PUBLIKASJONER

Planlagte publikasjoner:

1. Level of physical activity, cardiorespiratory fitness and cardiovascular disease risk factors in a rural adult population in Sogn og Fjordane
2. Secular trends in physical activity and cardiovascular disease risk factors in a 40-42-year-old rural population in the west of Norway from 1975 to 2010
3. Association between physical activity and cardiovascular disease risk factors in adulthood and objectively measured physical activity and BMI in middle-age – a 12-year follow-up study
4. Differences in determinants for physical activity among 40-42-year-olds in a rural population in Western Norway and a national population

GODKJENT TILGANG TIL NY FORSKNINGSFIL

Ja.

KONTRAKTENS VARIGHET

Kontrakten er forlenget til 31.12.2014

Sted og dato: Oslo 14.10.2011

Sigmund Anderssen
prosjektleder
Folkehelseinstituttet

Wenche Nystad
Folkehelseinstituttet
Databehandlingsansvarlig for Helseundersøkelsene

Skatteetaten

Saksbehandler	Deres dato	Vår dato
Grethe Telle	18.02.2008	24.02.2008
Telefon	Deres referanse	Vår referanse
22 07 74 79		2008/167522 /SKDRESF/GTE /341

Norges idrettshøgskole
Postboks 4014 Ullevål Stadion
0806 Oslo

Folkeregisteropplysninger

Skattedirektoratet viser til Deres brev av 18. februar d.å.

I henhold til lov om folkeregistrering § 14 annet ledd kan folkeregisteropplysninger utleveres til forskning, dersom det er rimelig, og det ikke medfører skade for vedkommendes interesser. Det er et vilkår at ansvarlig for undersøkelsen har formell forskerkompetanse, som amanuensis på høyskolenivå eller høyere. Opplysningene kan ikke benyttes til eller som en del av kommersiell virksomhet .

Vi tillater med dette at Norges idrettshøgskole på vegne av Sosial- og helsedirektoratet får trukket et tilfeldig utvalg bestående av til sammen ca 10 000 personer i alderes 20 til 80+ med norsk statsborgerskap. Det gis tilgang til følgende opplysninger:

- navn
- fødselsår
- adresseopplysninger. Det gis ikke tilgang til adresser som er underlagt taushetsplikt, spes. reg. 4, 5, 6 og 7
- fødekommune og fødeland
- sivilstatus
- antall barn

Iflg. ligningsloven § 3-13 nr. 3 bokstav a kan Finansdepartementet gi tillatelse til utlevering av ligningsopplysninger til forskningsformål i samsvar med forvaltningsloven § 13 bokstav d. De må følgelig sende søknad til Finansdepartementet for å få utlevert inntektsopplysninger.

Opplysningene skal brukes i forbindelse med en nasjonal kartleggingsundersøkelse av fysisk aktivitetsnivå og fysisk form hos den voksne og eldre delen av den norske befolkningen.

Opplysningene hentes fra EDB Business Partner Norge AS, Infobank, 2325 Hamar. Tekniske og kostnadsmessige spørsmål må avklares med leverandøren.

Dersom De ønsker kontakt med leverandøren, kan De ringe 625 80 700 eller sende e-post til dsf@edb.com. Dette gjelder også nærmere avtale/opplysninger om selve leveringen.

Tillatelsen gis på følgende vilkår:

Postadresse	Besøksadresse	Sentralbord
Postboks 6300 Etterstad	Fredrik Selmers vei 4	800 80 000
0603 Oslo	Org. nr: 974761076	Telefaks
skattedirektoratet@skatteetaten.no		22 07 71 08

1. De utleverte data må bare brukes til det oppgitte formål og må ikke leveres ut til andre.

2. I henhold til "Instruks for behandling av dokumenter som trenger beskyttelse av andre grunner enn de som er nevnt i Sikkerhetsloven med forskrifter" (fastsatt ved kgl.res. av 17. mars 1972) har Skattedirektoratet gradert de samlede opplysninger **FORTROLIG**. Dette innebærer at opplysningene må oppbevares på en slik måte at de ikke er tilgjengelig for uvedkommende.

3. Opplysningene er undergitt taushetsplikt. De må sørge for at personer som får kjennskap til innholdet, underskriver en taushetserklæring dersom dette ikke er gjort tidligere. Et eksemplar av en taushetserklæring er vedlagt og skal oppbevares av Dem.

4. Det må ikke publiseres resultatet fra undersøkelsen som kan gi opplysninger om identifiserbare personer.

5. Dersom intervjuobjektene får et løpenummer e.l., skal det fremgå at de via dette nummeret kan identifisere hvem som har besvart spørreskjemaet. Det må videre opplyses om hva som vil bli gjort med den oversikten som kan identifisere intervjuobjektene.

6. Når undersøkelsen er avsluttet, må alle identifikasjonsopplysninger fjernes fra disketten o.l., slik at individualopplysninger ikke kan brukes i samband med senere undersøkelser og /eller kobles sammen med personopplysninger fra andre kilder.

7. Kostnadene med oppdraget kalkuleres av datasentralen og må dekkes av Dem.

8. Tillatelsen gjelder kun for denne gangen. Dersom De ønsker tilsvarende opplysninger senere, må ny søknad sendes Skattedirektoratet.

Vi ber Dem bekrefte at De godtar og kan oppfylle pkt. 1-8 i tillatelsen. Når vi har mottatt dette, vil vi informere distributøren om at tillatelsen formelt er i orden.

Med hilsen

Kristin Os
seniorrådgiver
rettsavdelingen

Grethe Telle

Vedlegg

2007/333-6

Skattedirektoratet

Saksbehandler	Deres dato	Vår dato
Grethe Telle	04.11.2008	14.11.2008
Telefon	Deres referanse	Vår referanse
22 07 74 79		2008/167522/SKDRESF/GTE/341

Norges Idrettshøgskole
Postboks 4014 Ullevål Stadion
0806 Oslo

Folkeregisteropplysninger

* Vi viser til Deres brev av 4. november 2008.

Vår tillatelse av 15. juli 2008 utvides til også å gjelde fødselsnummer.

Med hilsen

Kristin Os
seniorrådgiver
rettsavdelingen

Grethe Telle

*Dette brev sendes til arkiv
for innskanning i saken!
Berit

Postadresse
Postboks 6300 Etterstad
0603 Oslo
skattedirektoratet@skatteetaten.no

Besøksadresse
Fredrik Selmers vei 4
Org. nr: 974761076

Sentralbord
800 80 000
Telefaks
22 07 71 08

Appendix II:

Study information and informed consent forms

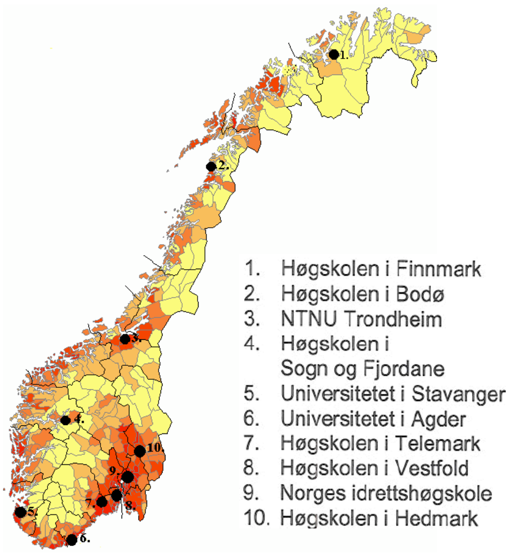
Kan1
Kartlegging aktivitet Norge

Førespurnad om deltaking i Kan1

– ei **kartleggingsundersøking** av fysisk aktivitet og fysisk form blant **vaksne** og **eldre**

HØGSKULEN i SOGN OG FJORDANE
NORGES IDRETTSHØGSKOLE
Helsedirektoratet

Kva er Kan1-undersøkinga?
Kan1 er ei landsomfattande kartlegging av aktivitetsnivå og fysisk form hjå befolkninga. Vi har i dag ikkje god nok informasjon på dette feltet til å kunne beskrive utviklingstrekk i befolkningsgrupper og geografiske område og forskjellar mellom dei. Denne undersøkinga er eitt ledd i Helsedirektoratet si Handlingsplan for fysisk aktivitet, der eit av hovudmåla er å etablere eit system for å kartleggje det fysiske aktivitetsnivået i befolkninga. Undersøkinga skal gjennomførast over heile landet i løpet av 2008 og 2009 og blir utført av desse høgskulane og universiteta:



Kva inneber det for deg å delta i undersøkinga?
Det inneber at du svarar på eit spørjeskjema og går med ein aktivitetsmålar i sju dagar. Aktivitetsmålaren er eit lite og lett apparat som du ber i eit elastisk belte rundt livet (sjå bilde på neste side). Du går med målaren i 7 dagar og returnerer han deretter saman med spørjeskjemaet i vedlagt returkonvolutt (Fase 1). I etterkant av Fase 1 vil om lag 1/4 av deltakarane bli tilfeldig trekte ut og inviterte til å gjennomføre ei tilleggsundersøking av fysisk form (Fase 2). Du kan delta i den første delen av undersøkinga, og seie nei til vidare deltaking.

KAN du delta?
Vel du å delta i Kan1-undersøkinga, bidreg du med viktig og ny kunnskap om aktivitetsnivå og fysisk form i befolkninga.

Alle kan delta, uavhengig om ein ser på seg sjølv som fysisk aktiv eller ikkje.

Formålet med undersøkinga er å kartleggje eit utval som representerer heile befolkninga, ikkje berre den delen som er mest aktiv.

Fordeler og ulemper
Deltek du i undersøkinga, får du i etterkant ei detaljert tilbakemelding på eige aktivitetsnivå. Du vil blant anna sjå om du oppfyller tilrådingane frå Helsedirektoratet for fysisk aktivitet. Dersom du blir invitert til vidare deltaking i Fase 2, vil du få tilbakemelding på eiga fysisk form. Test av fysisk form i Fase 2 kan gje deltakarar noko ubehag, då ein skal utføre enkelte øvingar med høg intensitet.

Kva skjer med informasjonen om deg?
All informasjon som blir innsamla om deg, blir behandla etter gjeldande lover og forskrifter. Alle medarbeidarar i undersøkinga har teieplikt, og opplysningane som blir innsamla, vil berre bli brukte til godkjende forskingsformål. Sjå avsnittet om personvern på neste side for meir informasjon.

Frivillig deltaking
Det er frivillig å delta i undersøkinga. Du kan når som helst trekkje deg utan å gje nokon grunn. Dersom du ønskjer å delta, underteiknar du samtykkeerklæringa på siste sida.

Kriterium for deltaking
Du må vera over 20 år, bu i Noreg og vera norsk statsborgar.

Tidsplan
I perioden april til november 2008 sender vi spørjeskjema og aktivitetsmålar til deltakaren. Denne delen av undersøkinga skjer berre per post og blir kalla Fase 1. Eit tilfeldig utval av deltakarane i Fase 1 (omtrent 1/4) blir inviterte til ei undersøking av fysisk form (Fase 2). Fase 2 vil finne stad to til seks månader etter hovudundersøkinga. Det er fullt mogleg å seie nei til deltaking i Fase 2, sjølv om ein har delteke i Fase 1.

Moglege biverknader
Det er ingen kjende biverknader ved å delta i undersøkinga. Test av fysisk form i Fase 2 kan gje noko ubehag, fordi ein skal utføre enkelte øvingar med høg intensitet. Eventuelle reiseutgifter for deltakarar som blir inviterte til deltaking i Fase 2, blir dekte av undersøkinga.

Personvern
Undersøkinga er godkjend av Regional komité for medisinsk og helsefaglig forskningsetikk Helseregion Sør avdeling B, REK Sør B. Undersøkinga er tilrådd av personvernombodet for forsking, Norsk samfunnsvitenskapelig datatjeneste A/S.

Opplysningar som blir registrerte om deg, er personalia som alder, kjønn, sivil status og etnisitet, i tillegg til opplysningar om blant anna aktivitet, kosthald og helse. Du kan vere trygg på at informasjonen du bidreg med til undersøkinga, blir behandla med respekt for personvern og privatliv, og i samsvar med lover og forskrifter.

Innsamla opplysningar blir oppbevarte slik at namn er erstatta med ein kode som viser til ei separat namneliste. Det er berre autorisert personell knytt til prosjektet som har tilgang til namnelista og som kan finne tilbake til deg. Det vil ikkje vere mogleg å identifisere deg i resultata av undersøkinga når dei blir publiserte.

Rett til innsyn og sletting av opplysningar om deg og sletting av prøver
Viss du seier ja til å delta i undersøkinga, har du rett til å få innsyn i kva for opplysningar som er registrerte om deg. Du har vidare rett til å få korrigert eventuelle feil i dei opplysningane vi har registrert. Dersom du trekkjer deg frå undersøkinga, kan du krevje å få sletta innsamla prøver og opplysningar, med mindre opplysningane allereie er gått inn i analysar eller brukte i vitskaplege publikasjonar.

Det kan bli aktuelt å hente inn opplysningar om deg frå nasjonale helseregister: Skade-, kreft-, dødsårsaks- og reseptregisteret. Vi ber om løyve frå deg til å hente inn tilleggsinformasjon frå desse registra. Alle innsamla opplysningar blir anonymiserte seinast innan 31.12.2020, med mindre vi før det har kontakta deg med førespurnad om noko anna.

Økonomi og Helsedirektoratet si rolle
Undersøkinga er finansiert og initiert av Helsedirektoratet.

Bilde 1 og 2. Aktivitetsmålaren i bruk

Kan1

Samtykke til deltaking i undersøkinga

Dette eksemplaret skriv du under og returnerer i vedlagde svarkonvolutt.
Den returnerte samtykkeerklæringa blir oppbevart på ein nedlåst stad.

Vennligst returner skjemaet innan ....

Eg er villig til å delta i undersøkinga

Ver vennleg å fylle ut opplysningane nedanfor:
(skriv tydeleg, helst med blokkbokstavar)

Fornamn:

....

Etternamn:

....

....
(Signer her)

Eg stadfestar å ha gjeve informasjon om undersøkinga

Sigmund Anderssen
....

Professor Sigmund Alfred Anderssen
Prosjektleiar
Seksjon for idrettsmedisin
Noregs idrettshøgskole

kartlegging **aktivitet** Norge 2008

Kan 1
Kartlegging aktivitet Norge

Invitasjon til den norske kartleggingsundersøkinga

I løpet av 2008-09 skal det gjennomførast ei nasjonal undersøking for å kartlegge fysisk aktivitetsnivå og fysisk form i den vaksne og eldre delen av befolkninga. Undersøkinga er i gangsett av Helsedirektoratet og blir administrert av Norges idrettshøgskole. Den blir utført lokalt ved 10 ulike høgskular og universitet i Noreg og Høgskulen i Sogn og Fjordane gjennomfører undersøkinga her i fylket.

Du er ein av rundt 1400 tilfeldig valde frå Sogn og Fjordane i alderen 20-85 år som blir inviterte til å delta. Det er viktig for oss å få informasjon om ditt aktivitetsnivå uansett kor mykje eller lite fysisk aktiv du er. Ved å delta bidreg du til å auke kunnskapen om fysisk aktivitet og helse. Slik informasjon er viktig for å kunne leggje til rette for helsefremmande fysisk aktivitet i befolkninga.

Alle svar og data vil bli behandla anonymt. Undersøkinga er godkjend av Regional komité for medisinsk og helsefagleg forskingsetikk og Datatilsynet. Me håpar du tek deg tid til å lese det vedlagte informasjonsskrivet der du finn meir informasjon om kva undersøkinga inneber.

Dersom du deltek i undersøkinga vil du vil få tilbakemelding om ditt aktivitetsnivå.

Deltakarane i Sogn og Fjordane blir med i en trekning av 1 flott sykkel og 2 gåvekort à kr 2000.

Me håper du vil delta!

Med venleg helsing

____

Ane Kristiansen Solbraa
Prosjektkoordinator Sogn og Fjordane
Høgskulen i Sogn og Fjordane

Har du har spørsmål kring undersøkinga, ta gjerne kontakt på:
Email: kan@hisf.no Telefon: 90953275 eller 57676081

Sjå www.nih.no/kan for meir informasjon om undersøkinga

Invitasjon til deltaking i kartleggingsundersøkinga, fase 2

Tusen takk for at du deltok i fase 1 av kartleggingsundersøkinga der du gjekk med aktivitetsmålar og svarte på spørjeskjema. Vi vil no invitera deg til vidare deltaking i undersøkinga ved å delta på ei personleg helseundersøking ved Høgskulen i Sogn og Fjordane.

Kva går undersøkinga ut på?
Undersøkinga inneheld ulike delar, mellom anna måling av

- lungefunksjon
- blodtrykk
- hjartefunksjon i kvile og under aktivitet ved gange på tredemølle
- fysisk form

I tillegg skal du ta ein blodprøve og gjennomføra enkle øvingar som kartlegg balanse, styrke og rørsle

Undersøkinga tek totalt ca 1 ½ time.

Kvifor delta?

- Undersøking av eiga helse
- Førebygging av framtidige helseproblem
- Du gjer ein viktig innsats for forsking

Tilbakemelding
Du vil få ein munnleg tilbakemelding av testleiar i høve din helsestatus og fysiske form.

Alle er like viktige!

Det er viktig at flest mogleg deltek i helseundersøkinga. Undersøkinga passar for alle personar, uansett alder og funksjonsnivå. Undersøkinga blir tilpassa den einskilde deltakar og ein gjennomfører kun dei testane ein sjølv ynskjer. Kvar deltakar er like viktig, uansett om ein er ung eller gamal, frisk eller sjuk.

Kan1
Kartlegging aktivitet Norge

Praktiske opplysingar

Ein representant frå høgskulen vil om kort tid ta kontakt per telefon for å svare på spørsmål, og eventuelt avtale eit tidspunkt for helseundersøkinga.

Etter telefonsamtalen vil du motta skriftleg stadfesting på oppmøtestad og tidspunkt.

Undersøkinga er gratis. Ved frammøte vil kvalifisert personell rettleie deg gjennom undersøkinga.

Litt informasjon om dei ulike del-undersøkingane

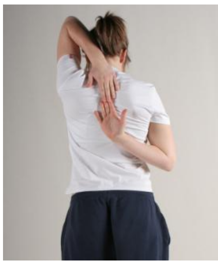
Lungefunksjon
Du skal puste så hardt du klarar i eit apparat. Mengde luft som blir blåst ut er eit mål på korleis lungene dine fungerar.

Blodtrykk
Blodtrykket blir målt på overarmen i kvile og under aktivitet.

Blodprøve
Det blir tatt ein blodprøve for å analysere blodverdiar som kolesterol, glukose og triglyserid.

Uthald
Uthald blir målt ved gange på tredemølle. Undervegs vil utåndings-gassar bli analysert og deltakaren får eit mål på eigen kondisjon.

Rørsle og styrke
Til slutt i undersøkinga blir det gjennomført eit testbatteri som inneheld enkle målingar som registrerer balanse, styrke og rørsle. Eksempel er måling av gripestyrke i hand, og rørsle i nakke og skulder.



Kva blir opplysningane nytta til?
Opplysningane frå undersøkinga vil kun bli brukt til forskning, og det vil ikkje være mogleg å identifisere enkeltpersonar ut ifrå resultata. I 1995-1996 gjennomførte Statens Helseundersøkelser ei screening-undersøking i Sogn og Fjordane der ditt årskull var inkludert. Viss du deltok i undersøkinga i 1996, ber vi om løyve til å koble resultata dine i Kan1 opp til helseopplysningane frå 1996.

Ta kontakt!
Dersom du lurer på noko, kontakt:

Ane Kristiansen Solbraa
Prosjektkoordinator Sogn og Fjordane
Kontor: 57 67 60 81
Mobil: 90 95 32 75
E-post: ane.solbraa@hisf.no

Samtykke

Takk for at du deltek i fase 2 i Kan-prosjektet. Denne delen av studien inneheld følgjande: måling av blodtrykk, blodprøve, lungefunksjon, test av uthald, rørsle, balanse og styrke. I tilegg vil vi ta mål relatert til høgde og vekt.

Videre ønsker vi å koble resultata frå Kan1 undersøkinga opp til tidlegare innsamla helseopplysningar. I 1996 gjennomførte Statens Helseundersøkelser ei screeningundersøking i Sogn og Fjordane. Ditt årskull var inkludert i denne screeningundersøkinga. Viss du deltok i undersøkinga i 1996 ber vi om løyve til å koble resultata dine frå Kan1 opp til helseopplysningane frå 1996. Dette vil gjelde for blodtrykk, total kolesterol, HDL-kolesterol, triglyserid og glukose, fysisk aktivitet frå spørjeskjema, høgde, vekt, evt. røykevanar, evt. tidlegare hjarte- og karsjukdom/diabetes. Innsamla opplysningar oppbevarast avidentifisert.

Blodprøvene som blir tatt og informasjonen frå dette materialet vil bli lagra i ein forskningsbiobank ved Norges idrettshøgskole. Viss du seier ja til å delta i studien, gir du også samtykke til at det biologiske materialet og analyseresultata inngår i biobanken. Professor Sigmund A. Anderssen er ansvarshavende for forskningsbiobanken. Biobanken planleggast å vare ut 2010. Etter dette vil materialet og opplysningane bli destruert og sletta etter interne retningslinjer.

Eg samtykker til å delta i studien og til at resultata frå Kan 1 blir kobla opp til helseopplysningane frå 1996.

____

Signatur

<table>
<tr><td>Etternamn:</td><td>Fornamn:</td><td>Født:</td></tr>
<tr><td colspan="3">Heimeadresse:</td></tr>
<tr><td colspan="3">Tlf (heim): E-mailadresse:

Tlf (mobil):</td></tr>
<tr><td colspan="3">Namn næraste pårørande:

Tlf næraste pårørande:</td></tr>
</table>

Egenerklæring

Dine idretts- og mosjonsvanar:

JA NEI

☐ ☐ 1. Mosjonerer du regelmessig med lettare kondisjonsaktivitetar (f.eks gåturar, lett jogging)?

☐ ☐ 2. Driv du regelmessig hardare kondisjonstrening og/eller konkurrer i kondisjonsidrettar?

☐ ☐ 1. Kjenner du til at du har ein hjartesjukdom?

☐ ☐ 2. Hender det du får brystsmerter i kvile eller i samband med fysisk aktivitet?

☐ ☐ 3. Kjenner du til at du har høgt blodtrykk?

☐ ☐ 4. Bruker du for tiden medisiner for høgt blodtrykk eller hjartesjukdom (f.eks. vanndrivande tablettar)?

☐ ☐ 5. Har nokon av dine foreldre, søsken eller barn fått hjarteinfarkt eller dødd plutselig (før fylte 55 år for menn og 65 for kvinner)?

☐ ☐ 6. Røyker du?

☐ ☐ 7. Kjenner du til om du har høgt kolesterolnivå i blodet?

☐ ☐ 8. Har du besvimt i løpet av dei siste 6 månader?

☐ ☐ 9. Hender det du mister balansen på grunn av svimmelheit?

☐ ☐ 10. Har du sukkersykje (diabetes)?

☐ ☐ 11. Kjenner du til <u>nokon annan grunn</u> til at di deltaking i prosjektet kan medføre helse- eller skaderisiko?

Har du ein sjukdom du tar medisinar for __ JA __ NEI
Viss JA, kva slags medisinar:

Gi beskjed straks dersom din helsesituasjon forandrar seg frå no og til undersøkinga er ferdig.
Dine eventuelle kommentarar til spørsmåla eller andre relevante opplysningar om eigen helsesituasjon med tanke på å gjennomføre fysiske testar:

____

____
Stad og dato

____
Underskrift

folkehelseinstituttet   HØGSKULEN I SOGN OG FJORDANE   NORGES IDRETTSHØGSKOLE

NN
NN
NN

1

TIL DEG SOM ER FØDT I 1954-56 OG ER HEIMEHØYRANDE I KOMMUNANE LUSTER, SOGNDAL OG LEIKANGER

Vi skriv til deg fordi du var invitert til å delta i Kartleggingsundersøkinga av fysisk aktivitet og fysisk form blant vaksne og eldre (Kan1) i 2008-2010. Ditt årskull var også invitert til å delta i ei undersøking Statens helseundersøkelser gjorde i Sogn og Fjordane i 1996. Nokre av dykk deltok også i helseundersøkingar i 1970- og 1980-åra. Høgskulen i Sogn og Fjordane (HSF), Norges idrettshøgskole og Folkehelseinstituttet samarbeider no om eit prosjekt for å undersøke utvikling i helsevanar og risikofaktorar for hjarte- og karsjukdom i Sogn og Fjordane basert på dei nemnde undersøkingane.

Nokre av dykk samtykka til kopling av opplysningar frå tidlegare innsamla data våren / hausten 2010. Førespurnaden du får no omfattar nokre fleire helseopplysningar og moglegheit for kopling mot fleire helseregister. Vi gir derfor moglegheit for reservasjon.

UNDERSØKINGAS HENSIKT
Kan1-undersøkinga hadde som hensikt å kartlegge fysisk aktivitetsnivå, fysisk form, medbestemmande faktorar for fysisk aktivitet og risiko for hjarte- og karsjukdom blant vaksne i Sogn og Fjordane. Undersøkinga inneheldt utfylling av spørjeskjema og registrering av fysisk aktivitet med ein aktivitetsmålar for alle deltakarane, samt at nokre av deltakarane også gjennomførte testing av helserelatert fysisk form.

For å få kjennskap til endringar i helsevanar og risikofaktorar for hjarte- og karsjukdom over tid og samanheng mellom desse og seinare helse og sjukdom, ønskjer vi å kople tidlegare innsamla opplysningar om deg, samt å kople desse opp mot opplysningar frå nasjonale helseregister som til dømes dødsårsaks-, kreft- og reseptregisteret.

For deg som deltok i Kan1-undersøkinga vil opplysningane bli kopla til data frå spørjeskjema og målingar i Kan1.

FRIVILLIG DELTAKING
Vi vil informere deg om denne undersøkinga, og at du kan si nei viss du ikkje vil at opplysningar om deg blir kopla. Viss du vil reservere deg mot koplinga, returnerer du reservasjonen som ligg vedlagt dette brevet innan 2 veker og seinast 14. mars 2011. Porto er betalt på førehand.

Viss du tillet at vi koplar opplysningane dine treng du ikkje sende inn noko.

ANONYMITET OG KONFIDENSIELL BEHANDLING
Opplysningar som blir registrert om deg vil bli anonymisert. Det vil seie at namn, fødselsnummer eller andre direkte gjenkjennande opplysningar blir sletta før helseopplysningane blir tilgjengeleg for forskaren. Det vil ikkje være mogleg å identifisere deg i resultata frå undersøkinga når desse publiserast.

KONTAKTINFORMASJON
Dersom du har spørsmål om undersøkinga og koplinga til tidlegare innsamla opplysningar, kan du ta kontakt med doktorgradsstipendiat Ane Solbraa på e-post ane.solbraa@hisf.no.

Vennleg helsing

Sigmund A. Anderssen
Professor, prosjektleiar
Norges idrettshøgskole/HSF

Sidsel Graff-Iversen
Forskar
Folkehelseinstituttet

Ane K. Solbraa
Doktorgradsstipendiat
Norges idrettshøgskole/HSF

Appendix III:

Questionnaires NHSS

Main questionnaire and additional questionnaire Kan1 and Kan1S&Fj

A

	JA	NEI
Har De, eller har De hatt:		
Hjerteinfarkt? 33		
Angina pectoris (hjertekrampe)? 34		
Annen hjertesykdom? 35		
Åreforkalkning i bena? 36		
Hjerneslag? 37		
Sukkersyke? 38		
Er De under behandling for:		
Høyt blodtrykk? 39		
Bruker De:		
Nitroglycerin? 40		

B

	JA	NEI
Får De smerter eller ubehag i brystet når De:		
Går i bakker, trapper eller fort på flat mark? 41		
Går i vanlig takt på flat mark? 42		
Hvis De får smerter eller ubehag i brystet ved gange, pleier De da å:		
1 Stanse? 43		
2 Saktne farten?		
3 Fortsette i samme takt?		
Hvis De stanser eller saktner farten, forsvinner smertene da:		
1 Etter mindre enn 10 minutter? 44		
2 Etter mer enn 10 minutter?		
Får De smerter i tykkleggen når De:		
Går? 45		
Er i ro? 46		
Hvis De får leggsmerter, besvar da:		
Forverres smertene ved raskere tempo eller i bakker? 47		
Gir smertene seg når De stopper? 48		
Har De vanligvis:		
Hoste om morgenen? 49		
Oppspytt fra brystet om morgenen? 50		

C

Bevegelse og kroppslig anstrengelse i Deres **fritid**.
Hvis aktiviteten varierer meget f.eks. mellom sommer og vinter så ta et gjennomsnitt.

Spørsmålet gjelder bare det siste året.

Sett kryss i den ruten hvor „JA" passer best.

	JA
1 Leser, ser på fjernsyn eller annen stillesittende beskjeftigelse? 51	
2 Spaserer, sykler eller beveger Dem på annen måte minst 4 timer i uken? (**Heri medregnes også gang eller sykling til arbeidsstedet, søndagsturer m.m.**)	
3 Driver mosjonsidrett, tyngre hagearbeid e.l.? (**Merk at yirksomheten skal vare minst 4 timer i uken.**)	
4 Trener hardt eller driver konkurranseidrett, regelmessig og flere ganger i uken?	

D

	JA	NEI
Røyker De daglig for tiden? 52		
Hvis svaret var „JA" på forrige spørsmål, besvar da:		
Røyker De sigaretter daglig? (håndrullede eller fabrikkframstilte) 53		
Hvis De ikke røyker sigaretter nå, besvar da:		
Har De røykt sigaretter daglig tidligere? 54		
Hvis De svarte „JA", hvor lenge er det siden De sluttet?		
1 Mindre enn 3 måneder? 55		
2 3 måneder - 1 år?		
3 1 - 5 år?		
4 Mer enn 5 år?		

Besvares av dem som røyker nå eller har røykt tidligere:

Hvor mange år tilsammen har De røykt daglig? 56-57	Antall år:
Hvor mange sigaretter røyker eller røykte De daglig? Oppgi antall pr. dag (håndrullede + fabrikkframstilte) 58-61	Ant. sigaretter:

	JA	NEI
Røyker De noe annet enn sigaretter daglig?		
Sigarer eller serutter / cigarillos? 62		
Pipe? 63		

Hvis De røyker pipe, hvor mange pakker tobakk (50 gram) bruker De i pipa pr. uke?

Oppgi gjennomsnittlig antall pakker pr. uke. 64-66	Ant. tobakkpk.

E

	JA	NEI
Har De vanligvis skiftarbeid eller nattarbeid? 67		
Kan De vanligvis komme hjem fra arbeidet:		
Hver dag? 68		
Hver helg? 69		
Har De i perioder lengre arbeidsdager enn vanlig? (f.eks. under sesongfiske, annearbeid) 70		

Har De i løpet av siste året hatt:

Sett kryss i den ruten hvor „JA" passer best.

	JA	NEI
1 Overveiende stillesittende arbeid? (f.eks. skrivebordsarb., urmakerarb., montering) 71		
2 Arbeid som krever at De går mye? (f.eks. ekspeditørarb., lett industriarb., undervisn.)		
3 Arbeid hvor De går og løfter mye? (f.eks. postbud, tyngre industriarb., bygningsarb.)		
4 Tungt kroppsarbeid? (f.eks. skogsarbeid, tungt jordbruksarb. tungt bygningsarb.)		
Har De i løpet av de siste 12 mnd måttet flytte fra hjemstedet på grunn av forandring i arbeidssituasjonen? 72		
Er husmorarbeid Deres hovedyrke? 73		
Har De i løpet av de siste 12 mnd fått arbeidsledighetstrygd? 74		
Er De for tiden sykmeldt, eller får De attføringspenger? 75		
Har De full eller delvis uførepensjon? 76		

F

	JA	NEI	VET IKKE
Har en eller flere av foreldre eller søsken hatt hjerteinfarkt (sår på hjertet) eller angina pectoris (hjertekrampe)? 77			

G

	JA	NEI
Har noen i Deres husstand (utenom Dem selv) vært innkalt til nærmere undersøkelse hos distriktslegen etter forrige hjerte-kar undersøkelse? 80		

MELDING OM SKJERMBILDEFOTOGRAFERING
OG HJERTE-KARUNDERSØKELSE

(Gjelder bare den person brevet er adressert til)

Skjermbildefotograferingen kommer nå til Deres distrikt.

Tid og sted for Deres frammøte vil De finne nedenfor.

Denne gangen vil en del av befolkningen også få tilbud om hjerte-karundersøkelse. De tilhører denne gruppe. En orientering om undersøkelsen er gitt i vedlagte brosjyre.

Vennligst fyll ut spørreskjemaet på baksiden og ta det med til undersøkelsen. Ta også med skjermbildebevis, tuberkulinkort eller helsebok om De har.

Fravær bes eventuelt meldt på vedlagte seddel.

Med hilsen

HELSERÅDET FYLKESLEGEN
STATENS SKJERMBILDEFOTOGRAFERING

Født dato	Personnr.	Kommune	Kretsnr.

Møtested	Kjønn	Første bokstav etternavn	Dag og dato	Klokkeslett

SKRIV IKKE HER!

T. S. M.: 17 M: 18 19 / 24 25 / 30 31 32

A FAMILIE

Har en eller flere av foreldre eller søsken hatt hjerteinfarkt (sår på hjertet) eller angina pectoris (hjertekrampe)? ..... 12 — JA / NEI / VET IKKE

B EGEN SYKDOM

Har De, eller har De hatt: — JA / NEI
- Hjerteinfarkt? 13
- Angina pectoris (hjertekrampe)? 14
- Hjerneslag? 15
- Sukkersyke? 16

Er De under behandling for:
- Høyt blodtrykk? 17

Bruker De:
- Nitroglycerin? 18

C SYMPTOMER

Får De smerter eller ubehag i brystet når De: — JA / NEI
- Går i bakker, trapper eller fort på flat mark? 19
- Går i vanlig takt på flat mark? 20

Dersom De får smerter eller vondt i brystet ved gange, pleier De da å:
- Stoppe? ..... 21 — 1
- Saktne farten? 2
- Fortsette i samme takt? 3

Dersom De stopper eller saktner farten, forsvinner smertene da:
- Etter mindre enn 10 minutter? ..... 22 — 1
- Etter mer enn 10 minutter? 2

Har De vanligvis: — JA / NEI
- Hoste om morgenen? 23
- Oppspytt fra brystet om morgenen? 24

D MOSJON

Bevegelse og kroppslig anstrengelse i Deres fritid. Hvis aktiviteten varierer meget f.eks. mellom sommer og vinter, så ta et gjennomsnitt. Spørsmålet gjelder bare det siste året.
Sett kryss i den ruta hvor «JA» passer best
- Leser, ser på fjernsyn eller annen stillesittende beskjeftigelse? ..... 25 — 1
- Spaserer, sykler eller beveger Dem på annen måte minst 4 timer i uka? ..... — 2
  (Her skal De også regne med gang eller sykling til arbeidsstedet, søndagsturer m.m.)
- Driver mosjonsidrett, tyngre hagearbeid e.l.? ..... — 3
  (Merk at aktiviteten skal vare minst 4 timer i uka).
- Trener hardt eller driver konkurranseidrett regelmessig og flere ganger i uka? ..... — 4

E SALT/FETT

Hvor ofte bruker De salt kjøtt eller salt fisk til middag?
Sett kryss i den ruta hvor «JA» passer best
- Aldri eller sjeldnere enn en gang i måneden ..... 26 — 1
- Opptil en gang i uka ..... — 2
- Opptil to ganger i uka ..... — 3
- Mer enn to ganger i uka ..... — 4

Hvor ofte pleier De strø ekstra salt på middagsmaten?
Sett kryss i den ruta hvor «JA» passer best
- Sjelden eller aldri ..... 27 — 1
- Av og til eller ofte ..... — 2
- Alltid eller nesten alltid ..... — 3

Hva slags margarin eller smør bruker De til vanlig på brød?
Sett kryss i den ruta hvor «JA» passer best
- Bruker ikke smør eller margarin på brød ..... 28 — 1
- Smør ..... — 2
- Hard margarin ..... — 3
- Myk (Soft) margarin ..... — 4
- Smør/margarin blanding ..... — 5

Hva slags fett blir til vanlig brukt til matlaging i Deres husholdning?
Sett kryss i den ruta hvor «JA» passer best
- Smør eller hard margarin ..... 29 — 1
- Myk (Soft) margarin eller olje ..... — 2
- Smør/margarin blanding ..... — 3

F RØYKING

- Røyker De daglig for tiden? ..... 30 — JA / NEI

Hvis svaret er «JA», svar da på dette:
- Røyker De sigaretter daglig? 31
  (håndrullet eller fabrikkframstilte)

Hvis De ikke røyker sigaretter nå, besvar da:
- Har De røykt sigaretter daglig tidligere? 32

Hvis De svarte «JA», hvor lenge er det siden De sluttet?
- Mindre enn 3 måneder? ..... 33 — 1
- 3 måneder – 1 år? ..... — 2
- 1–5 år? ..... — 3
- Mer enn 5 år? ..... — 4

Besvares av dem som røyker nå eller som har røykt tidligere:
- Hvor mange år tilsammen har De røykt daglig? ..... 34 — Antall år
- Hvor mange sigaretter røyker eller røykte De daglig? Oppgi tallet på sigaretter daglig ..... 36 — Antall sigaretter
  (håndrullet + fabrikkframstilte)

Røyker De noe annet enn sigaretter daglig? — JA / NEI
- Sigarer eller sérutter/sigarillos? 40
- Pipe? 41

Hvis De røyker pipe, hvor mange pakker tobakk (50 gram) bruker De i pipa pr. uke?
- Oppgi gjennomsnittlig antall pakker pr. uke ..... 42 — Ant. tobakk pk.

G KAFFE

Hvor mange kopper kaffe drikker De vanligvis daglig?
Sett kryss i den ruta hvor «JA» passer best
- Drikker ikke kaffe, eller mindre enn en kopp ..... 45 — 1
- 1 – 4 kopper ..... — 2
- 5 – 8 kopper ..... — 3
- 9 eller flere kopper ..... — 4

Hva slags kaffe drikker De vanligvis daglig?
- Kokekaffe 46
- Filterkaffe 47
- Pulverkaffe 48
- Koffeinfri kaffe 49
- Drikker ikke kaffe 50

H ARBEID

- Har De i løpet av de siste 12 måneder fått arbeidsledighetstrygd? ..... 51 — JA / NEI
- Er De for tiden sykmeldt, eller får De attføringspenger? 52
- Har De full eller delvis uførepensjon? 53
- Har De vanligvis skiftarbeid eller nattarbeid 54

Har De i det siste året hatt:
Sett kryss i den ruta hvor «JA» passer best
- For det meste stillesittende arbeid? ..... 55 — 1
  (f.eks. skrivebordsarb., urmakerarb., montering)
- Arbeid som krever at De går mye? ..... — 2
  (f.eks. ekspeditørarb., lett industriarb., undervisn.)
- Arbeid hvor De går og løfter mye? ..... — 3
  (f.eks. postbud, tyngre industriarb., bygningsarb.)
- Tungt kroppsarbeid? ..... — 4
  (f.eks. skogsarb., tungt jordbruksarb., tungt bygn.arb.)

- Er husmorarbeid hovedyrket Deres? ..... 56 — JA / NEI

I ETTERUNDERSØKELSE

Hvis denne helseundersøkelsen viser at De bør undersøkes nærmere:
Hvilken almenpraktiserende lege ønsker De da å bli henvist til?

Skriv navnet på legen her

..... 57 — Ikke skriv her

Ingen spesiell lege .....

60 — Ikke skriv her

A FAMILIE

Har en eller flere av foreldre eller søsken hatt hjerteinfarkt (sår på hjertet) eller angina pectoris (hjertekrampe)? .... 12 — JA / NEI / VET IKKE

B EGEN SYKDOM

Har De, eller har De hatt: (JA / NEI)

- Hjerteinfarkt? 13
- Angina pectoris(hjertekrampe)? 14
- Hjerneslag? 15
- Sukkersyke? 16

Hvis De har sukkersyke, i hvilket år ble diagnosen stillet? .... 17 — 19____

Er De under medikamentell behandling for høyt blodtrykk? .... 18 — JA / NEI

C SYMPTOMER

Får De smerter eller ubehag i brystet når De: (JA / NEI)

- Går i bakker, trapper eller fort på flat mark? 20
- Går i vanlig takt på flat mark? 21

Dersom De får smerter eller vondt i brystet ved gange, pleier De da å:

- Stoppe? .... 22 — 1
- Saktne farten? 2
- Fortsette i samme takt? 3

Dersom De stopper eller saktner farten, forsvinner smertene da:

- Etter mindre enn 10 minutter? .... 23 — 1
- Etter mer enn 10 minutter? 2

Har De vanligvis: (JA / NEI)

- Hoste om morgenen? 24
- Oppspytt fra brystet om morgenen? 25

D MOSJON

Bevegelse og kroppslig anstrengelse i Deres fritid. Hvis aktiviteten varierer meget f.eks. mellom sommer og vinter, så ta et gjennomsnitt. Spørsmålet gjelder bare det siste året.
Sett kryss i den ruta hvor «JA» passer best

- Leser, ser på fjernsyn eller annen stillesittende beskjeftigelse? .... 26 — 1
- Spaserer, sykler eller beveger Dem på annen måte minst 4 timer i uka? 2
  (Her skal De også regne med gang eller sykling til arbeidsstedet, søndagsturer m.m.)
- Driver mosjonsidrett, tyngre hagearbeid e.l.? 3
  (Merk at aktiviteten skal vare minst 4 timer i uka.)
- Trener hardt eller driver konkurranseidrett regelmessig og flere ganger i uka? 4

E SALT/FETT

Hvor ofte bruker De salt kjøtt eller salt fisk til middag?
Sett kryss i den ruta hvor «JA» passer best

- Aldri eller sjeldnere enn en gang i måneden .... 27 — 1
- Opptil en gang i uka 2
- Opptil to ganger i uka 3
- Mer enn to ganger i uka 4

Hvor ofte pleier De strø ekstra salt på middagsmaten?
Sett kryss i den ruta hvor «JA» passer best

- Sjelden eller aldri .... 28 — 1
- Av og til eller ofte 2
- Alltid eller nesten alltid 3

Hva slags margarin eller smør bruker De til vanlig på brød?
Sett kryss i den ruta hvor «JA» passer best

- Bruker ikke smør eller margarin på brød .... 29 — 1
- Smør 2
- Hard margarin 3
- Myk (Soft) margarin 4
- Smør/margarin blanding 5

Hva slags fett blir til vanlig brukt til matlaging i Deres husholdning?
Sett kryss i den ruta hvor «JA» passer best

- Smør eller hard margarin .... 30 — 1
- Myk (Soft) margarin eller olje 2
- Smør/margarin blanding 3

F RØYKING

Røyker De (JA / NEI)

- Sigaretter daglig? 31
  (håndrullet eller fabrikkframstilte)
- Sigarer eller serutter/sigarillos daglig? 32
- Pipe daglig? 33

Hvis De ikke røyker daglig nå, besvar da:

- Har De røykt daglig tidligere? 34

Hvis De svarte «JA», hvor lenge er det siden De sluttet?

- Mindre enn 1 år? .... 35 — 1
- Mer enn 1 år? 2

Besvares av dem som røyker nå eller som har røykt tidligere:

- Hvor mange år tilsammen har De røykt daglig? .... 36 — Antall år
- Hvor mange sigaretter røyker eller røykte De daglig? Oppgi tallet på sigaretter daglig .... 38 — Antall sigaretter
  (håndrullet + fabrikkframstilte)

G KAFFE

Hvor mange kopper kaffe drikker De vanligvis daglig?
Sett kryss i den ruta hvor «JA» passer best

- Drikker ikke kaffe, eller mindre enn en kopp .... 42 — 1
- 1–4 kopper 2
- 5–8 kopper 3
- 9 eller flere kopper 4

Hva slags kaffe drikker De vanligvis daglig?

- Kokekaffe 43
- Filterkaffe 44
- Pulverkaffe 45
- Koffeinfri kaffe 46
- Drikker ikke kaffe 47

H ARBEID

Har De i det siste året hatt:
Sett kryss i den ruta hvor «JA» passer best

- For det meste stillesittende arbeid? .... 48 — 1
  (f.eks. skrivebordsarbeid, urmakerarbeid, montering)
- Arbeid som krever at De går mye? 2
  (f.eks. ekspeditørarb., lett industriarb., undervisning)
- Arbeid hvor De går og løfter mye? 3
  (f.eks. postbud, tyngre industriarb., bygningsarbeid)
- Tungt kroppsarbeid? 4
  (f.eks. skogsarb., tungt jordbruksarb., tungt bygn.arb.)

Har De i Deres arbeid noen gang vært i kontakt med: (JA / NEI / VET IKKE)

- Asbeststøv? 49
- Kvartsstøv? 50

(JA / NEI)

Har De vanligvis skiftarbeid eller nattarbeid? 51

Er husarbeid i hjemmet hovedyrket Deres? 52
(Svar: «NEI» hvis lønnet arbeid utenom husarbeid er 18 timer eller mer pr. uke)

Har De daglig omsorg for syke eller funksjonshemmede i familien? 53

Har De i løpet av de siste 12 måneder fått arbeidsledighetstrygd? 54

Er De for tiden sykmeldt, eller får De attføringspenger? 55

Har De full eller delvis uførepensjon? 56

I ETTERUNDERSØKELSE

(JA / NEI / VET IKKE)

Er to eller flere av dine besteforeldre av finsk ætt? 57

Er to eller flere av dine besteforeldre av samisk ætt? 58

Hvis denne helseundersøkelsen viser at du bør undersøkes nærmere:
Hvilken almenpraktiserende lege/kommunelege ønsker du da å bli henvist til?

Skriv navnet på legen her

.... 59 — Ikke skriv her

Ingen spesiell lege .... 62 — Ikke skriv her

NHSS 1996

EGEN HELSE

Hvordan er helsen din nå? *Sett bare ett kryss.*

- Dårlig ... 12 ☐ 1
- Ikke helt god ... ☐ 2
- God ... ☐ 3
- Svært god ... ☐ 4

Har du, eller har du hatt:

		JA	NEI	Alder første gang
Hjerteinfarkt	13			år
Angina pectoris (hjertekrampe)	16			år
Hjerneslag/hjerneblødning	19			år
Astma	22			år
Diabetes (sukkersyke)	25			år

Bruker du medisin mot høyt blodtrykk?

- Nå ... 28 ☐ 1
- Før, men ikke nå ... ☐ 2
- Aldri brukt ... ☐ 3

Hvis ja, hvilket merke bruker du nå?

Ikke skriv her

Har du i løpet av det siste året vært plaget med smerter og/eller stivhet i muskler og ledd som har vart i minst 3 måneder sammenhengende? 33 JA NEI

Har du de siste to ukene følt deg:

		Nei	Litt	En god del	Svært mye
Nervøs og urolig?	34				
Plaget av angst?	35				
Trygg og rolig?	36				
Irritabel?	37				
Glad og optimistisk?	38				
Nedfor/deprimert?	39				
Ensom?	40				
		1	2	3	4

Får du smerter eller ubehag i brystet når du: JA NEI

Går i bakker, trapper eller fort på flat mark? ... 41

Hvis du får slike smerter, pleier du da å:

- Stoppe? ... 42 ☐ 1
- Sakne farten? ... ☐ 2
- Fortsette i samme takt? ... ☐ 3

		JA	NEI
Dersom du stopper, forsvinner smertene da etter mindre enn 10 minutter?	43		
Kan slike smerter like gjerne opptre mens du er i ro?	44		

Mottar du nå noen av følgende ytelser?

- Syketrygd (sykmeldt) ... 45 ☐
- Attføringspenger ... 46 ☐
- Uførepensjon (hel eller delvis) ... 47 ☐
- Arbeidsledighetstrygd ... 48 ☐

ENDRING AV HELSEVANER

Dette gjelder din interesse for å endre helsevaner. Røykespørsmålet besvares bare av dem som røyker.

		Spise sunnere JA	Spise sunnere NEI	Trimme mer JA	Trimme mer NEI	Slutte å røyke JA	Slutte å røyke NEI
Har du de siste 12 mnd. forsøkt å:	49						
Om 5 år, tror du at du har endret vaner på noen av disse områdene?	52						

		Høyeste vekt:	Laveste vekt:
Anslå din høyeste og laveste vekt i løpet av de siste 5 år. (*Se bort fra vekt under svangerskap*)	55	kg	kg

SYKDOM I FAMILIEN

		JA	NEI	VET IKKE
Har en eller flere av foreldre eller søsken hatt hjerteinfarkt (sår på hjertet) eller angina pectoris (hjertekrampe)?	61			

Har én eller flere foreldre/søsken hatt:

		JA	NEI
Hjerteinfarkt *før* de fylte 60 år?	62		
Hjerneslag *før* de fylte 70 år?	63		

RØYKING

Hvor lenge er du vanligvis daglig til stede i røykfylt rom? ... 64 Antall timer

Sett 0 hvis du ikke oppholder deg i røykfylt rom.

Røyker du selv?

		JA	NEI
Sigaretter daglig?	66		
Sigarer/sigarillos daglig?	67		
Pipe daglig?	68		

Hvis du har røykt daglig tidligere, hvor lenge er det siden du sluttet? ... 69 Antall år

Hvis du røyker daglig nå eller har røykt tidligere:

- Hvor mange sigaretter røyker eller røykte du vanligvis daglig? ... 71 Antall sigaretter
- Hvor gammel var du da du begynte å røyke daglig? ... 75 Alder år
- Hvor mange år tilsammen har du røykt daglig? ... 77 Antall år

MOSJON

Hvordan har din fysiske aktivitet i fritiden vært det siste året? *Tenk deg et ukentlig gjennomsnitt for året. Arbeidsvei regnes som fritid.*

		Timer pr. uke Ingen	Under 1	1-2	3 og mer
Lett aktivitet *(ikke svett/andpusten)*	79				
Hard fysisk aktivitet *(svett/andpusten)*	80				
		1	2	3	4

KAFFE/TE/ALKOHOL

Hvor mange kopper kaffe/te drikker du daglig? *Sett 0 hvis du ikke drikker kaffe/te daglig.*

- Kokekaffe ... 81 Antall kopper
- Annen kaffe ... 83 Antall kopper
- Te ... 85 Antall kopper

Er du total avholdsmann/-kvinne? ... 87 JA NEI

Hvor mange ganger i måneden drikker du vanligvis alkohol? *Regn ikke med lettøl. Sett 0 hvis mindre enn 1 gang i mnd.* ... 88 Antall ganger

Hvor mange glass øl, vin eller brennevin drikker du vanligvis i løpet av to uker? 90

Regn ikke med lettøl. Sett 0 hvis du ikke drikker alkohol.

Øl	Vin	Brennevin
glass	glass	glass

FETT

Hva slags margarin eller smør bruker du vanligvis på brødet? *Sett ett kryss.*

- Bruker ikke smør/margarin ... 96 ☐ 1
- Meierismør ... ☐ 2
- Hard margarin ... ☐ 3
- Bløt (soft) margarin ... ☐ 4
- Smør/margarin blanding ... ☐ 5
- Lettmargarin ... ☐ 6

UTDANNING

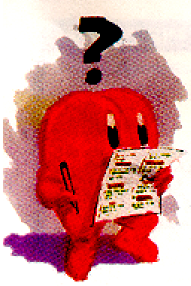
Hvilken utdanning er den høyeste du har fullført?

- Grunnskole 7-10 år, framhaldsskole, folkehøgskole ... 97 ☐ 1
- Realskole, middelskole, yrkesskole, 1-2 årig videregående skole ... ☐ 2
- Artium, øk.gymnas, allmennfaglig retning i videregående skole ... ☐ 3
- Høgskole/universitet, mindre enn 4 år ... ☐ 4
- Høgskole/universitet, 4 år eller mer ... ☐ 5

ETTERUNDERSØKELSE

Hvis denne helseundersøkelsen viser at du bør undersøkes nærmere, hvilken allmennpraktiserende lege/kommunelege ønsker du da å bli henvist til? Oppgi legens navn:

Ikke skriv her



Spørreskjemaet er en viktig del av helseundersøkelsen. Vennligst fyll ut skjemaet på forhånd og ta det med til helseundersøkelsen. Dersom enkelte spørsmål er uklare, lar du dem stå ubesvart til du møter fram, og drøfter dem med personalet som gjennomfører undersøkelsen. *Alle svar vil bli behandlet strengt fortrolig.*

Det utfylte skjemaet vil bli lest av en maskin. Bruk blå eller sort farge ved utfylling. Det er viktig at du går fram slik:

- i de små boksene setter du kryss for det svaret som passer best for deg
- i de store boksene skriver du tall eller blokkbokstaver – NB! innenfor rammen for boksen.

Eksempler:
Avkryssing: ☒ Tall: 1 2 3 4 5 6 7 8 9 0 Bokstaver: A B C

Med vennlig hilsen

Statens helseundersøkelser ♥ Kommunehelsetjenesten

1. EGEN HELSE

Hvordan er helsen din nå? *(Sett bare ett kryss)*

Dårlig	Ikke helt god	God	Svært god
☐ 1	☐ 2	☐ 3	☐ 4

Har du, eller har du hatt:

	JA	NEI	Alder første gang
Hjerteinfarkt	☐	☐	år
Angina pectoris (hjertekrampe)	☐	☐	år
«Hjerneslag/hjerneblødning («drypp»)	☐	☐	år
Astma	☐	☐	år
Diabetes (sukkersyke)	☐	☐	år

Får du smerter eller ubehag i brystet når du:

	JA	NEI
Går i bakker, trapper eller fort på flat mark?	☐	☐

Hvis du får slike smerter, pleier du da å:

Stoppe?	Saktne farten?	Fortsette i samme takt?
☐ 1	☐ 2	☐ 3

	JA	NEI
Dersom du stopper, forsvinner smertene da etter mindre enn 10 minutter?	☐	☐
Kan slike smerter like gjerne opptre mens du er i ro?	☐	☐

2. HVORLEDES FØLER DU DEG?

Har du de siste to ukene følt deg:

	Nei	Litt	En god del	Svært mye
Nervøs og urolig?	☐	☐	☐	☐
Plaget av angst?	☐	☐	☐	☐
Trygg og rolig?	☐	☐	☐	☐
Irritabel?	☐	☐	☐	☐
Glad og optimistisk?	☐	☐	☐	☐
Nedfor/deprimert?	☐	☐	☐	☐
Ensom?	☐	☐	☐	☐
	1	2	3	4

3. SYKDOM I FAMILIEN

	JA	NEI	VET IKKE
Har en eller flere av foreldre eller søsken hatt hjerteinfarkt (sår på hjertet) eller angina pectoris (hjertekrampe)?	☐	☐	☐

Har en eller flere foreldre/søsken hatt:

Hjerteinfarkt *før* de fylte 60 år?	☐	☐	☐
Hjerneslag/hjerneblødning *før* de fylte 70 år?	☐	☐	☐

4. MUSKEL/SKJELETT-PLAGER

	JA	NEI
Har du i løpet av det siste året vært plaget med smerter og/eller stivhet i muskler og ledd som har vart i minst 3 måneder sammenhengende?	☐	☐

Hvis NEI, gå til avsnitt 5. SOSIALE FORHOLD.
Hvis JA, svar på følgende:

Hvor har du hatt disse plagene?

	JA	NEI
Nakke	☐	☐
Skuldre (aksler)	☐	☐
Albuer	☐	☐
Håndledd/hender	☐	☐
Bryst, mage	☐	☐
Øvre del av ryggen	☐	☐
Korsryggen	☐	☐
Hofter	☐	☐
Knær	☐	☐
Ankler, føtter	☐	☐

Hvor lenge har plagene vart sammenhengende?
Svar for det området hvor plagene har vart lengst.

Hvis under 1 år, oppgi antall mnd. .... *Antall mnd.*

Hvis 1 år eller mer, oppgi antall år .... *Antall år*

Har plagene redusert din arbeidsevne det siste året?
Gjelder også hjemmearbeidende. Sett bare ett kryss.

Nei/ubetydelig	I noen grad	I betydelig grad	Vet ikke
☐ 1	☐ 2	☐ 3	☐ 4

	JA	NEI	Ikke i arbeid
Har du vært sykmeldt pga. disse plagene det siste året?	☐	☐	☐

	JA	NEI
Har plagene ført til redusert aktivitet i fritida?	☐	☐

5. SOSIALE FORHOLD

Mottar du nå noen av følgende ytelser?

	JA	NEI
Syketrygd (sykmeldt)	☐	☐
Attføringspenger	☐	☐
Uførepensjon (hel eller delvis)	☐	☐
Arbeidsledighetstrygd	☐	☐

	JA	NEI
Er husarbeid i hjemmet hovedyrket ditt? *(Svar NEI hvis lønnet arbeid utenom husarbeid er 18 timer eller mer pr. uke)*	☐	☐

6. UTDANNING

Hvilken utdanning er den høyeste du har fullført?
Sett bare ett kryss.

- Mindre enn 7 år grunnskole ☐
- Grunnskole 7-10 år, framhaldsskole, folkehøgskole ☐ 1
- Realskole, middelskole, yrkesskole, 1-2 årig videregående skole ☐ 2
- Artium, øk.gymnas, allmennfaglig retning i videregående skole ☐ 3
- Høgskole/universitet, mindre enn 4 år ☐ 4
- Høgskole/universitet, 4 år eller mer ☐ 5

7. KOST

Hvor ofte bruker du disse matvarene?
Sett kryss i de rutene som beskriver ditt forbruk best.

	Flere g. daglig	Daglig	1-6 g. pr.uke	1-3 g. pr.mnd	Sjelden eller aldri
Fisk (middag, pålegg)	☐	☐	☐	☐	☐
Frukt/grønt	☐	☐	☐	☐	☐
Helmelk, kefir, yoghurt	☐	☐	☐	☐	☐
Lettmelk, lettyoghurt	☐	☐	☐	☐	☐
Skummet melk (sur/søt)	☐	☐	☐	☐	☐
	1	2	3	4	5

Hva slags smør eller margarin bruker du vanligvis PÅ BRØDET?
Sett kryss i den ruta som passer best.

- Bruker ikke smør/margarin ☐ 1
- Meierismør ☐ 2
- Hard margarin ☐ 3
- Bløt (soft) margarin ☐ 4
- Smør/margarin blanding ☐ 5
- Lettmargarin/lettsmør (Brelett) ☐ 6

Hva slags fett bruker du/dere vanligvis TIL MATLAGING?
Sett kryss i den ruta som passer best.

- Smør/margarin ☐ 1
- Myk (soft) margarin/olje ☐ 2
- Bare olje ☐ 3
- Vet ikke ☐ 4

8. KAFFE / TE / ALKOHOL

Hvor mange kopper kaffe/te drikker du daglig?
Sett 0 hvis du ikke drikker kaffe/te daglig.

Antall kopper daglig

Kokekaffe	Annen kaffe	Te
☐☐	☐☐	☐☐

Er du total avholdsmann/-kvinne? JA ☐ NEI ☐

Hvor mange ganger i måneden drikker du vanligvis alkohol? *Regn ikke med lettøl.*
Sett 0 hvis mindre enn 1 gang i mnd. .... *Antall ganger* ☐☐

Hvor mange glass øl, vin eller brennevin drikker du VANLIGVIS i løpet av to uker?
Regn ikke med lettøl. Sett 0 hvis du ikke drikker alkohol.

Glass øl	Glass vin	Glass brennevin
☐☐	☐☐	☐☐

9. RØYKING

Hvor lenge er du vanligvis daglig tilstede i røykfylt rom? .... *Antall hele timer* ☐☐
Sett 0 hvis du ikke oppholder deg i røykfylt rom.

Røyker du selv:

	JA	NEI
Sigaretter daglig?	☐	☐
Sigarer/sigarillos daglig?	☐	☐
Pipe daglig?	☐	☐

Aldri røykt daglig .... (Sett kryss) ☐

Hvis du har røykt daglig tidligere, hvor lenge er det siden du sluttet? .... *Antall år* ☐☐

Hvis du røyker daglig nå eller har røykt tidligere:

- Hvor mange sigaretter røyker eller røykte du vanligvis daglig? .... *Antall sigaretter* ☐☐
- Hvor gammel var du da du begynte å røyke daglig? .... *Alder i år* ☐☐
- Hvor mange år til sammen har du røykt daglig? .... *Antall år* ☐☐

10. MOSJON

Hvordan har din fysiske aktivitet i fritiden vært det siste året?
Tenk deg et ukentlig gjennomsnitt for året.
Arbeidsvei regnes som fritid. Besvar begge spørsmålene.

Timer pr. uke

	Ingen	Under 1	1-2	3 og mer
Lett aktivitet (*ikke svett/andpusten*)	☐	☐	☐	☐
Hard fysisk aktivitet (*svett/andpusten*)	☐	☐	☐	☐
	1	2	3	4

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 kryss i den ruta som passer best.

- Leser, ser på fjernsyn eller annen stillesittende beskjeftigelse? ☐ 1
- Spaserer, sykler eller beveger deg på annen måte minst 4 timer i uka? ☐ 2
  (Her skal du også regne med gang eller sykling til arbeidsstedet, søndagsturer m.m.)
- Driver mosjonsidrett, tyngre hagearbeid e.l.? ☐ 3
  (Merk at aktiviteten skal vare minst 4 timer i uka)
- Trener hardt eller driver konkurranseidrett regelmessig og flere ganger i uka? ☐ 4

11. ENDRING AV HELSEVANER

Dette gjelder din interesse for å endre helsevaner. Røykespørsmålet besvares bare av dem som røyker.

	Spise sunnere JA	Spise sunnere NEI	Trimme mer JA	Trimme mer NEI	Slutte å røyke JA	Slutte å røyke NEI
Har du de siste 12 mnd. forsøkt å:	☐	☐	☐	☐	☐	☐
Om 5 år, tror du at du har endret vaner på noen av disse områdene?	☐	☐	☐	☐	☐	☐

Anslå din høyeste og laveste vekt i løpet av de siste 5 år. *(Hele kg)*
(Se bort fra vekt under svangerskap)

Høyeste vekt	Laveste vekt
☐☐☐	☐☐☐

VEND!

12. MEDISIN MOT HØYT BLODTRYKK

Bruker du medisin mot høyt blodtrykk?

Nå ☐ 1 Før, men ikke nå ☐ 2 Aldri brukt ☐ 3

Hvis du bruker medisin nå, hvilke(t) merke(r) bruker du?

Ikke skriv i disse rutene

13. MEDISIN MOT HØYT KOLESTEROL

	JA	NEI
Bruker du kolesterolsenkende medisiner NÅ?	☐	☐

Hvis NEI, gå til 14. ETTERUNDERSØKELSE.

Hvor gammel var du da du begynte med kolesterolsenkende medisiner? .... *Alder i år*

Hvis du bruker kolesterolsenkende medisiner, hva var grunnen til at du begynte med slik medisin?
(Sett kryss i de rutene som passer for deg.)

	JA	NEI
Hjerteinfarkt	☐	☐
Angina pectoris (hjertekrampe, brystkrampe)	☐	☐
Høyt innhold av kolesterol i blodet	☐	☐
Hjertesykdom i familien (foreldre, søsken)	☐	☐
Hjerneslag/hjerneblødning/ «drypp»	☐	☐
Dårlig blodsirkulasjon i bena (åreforkalkning, «røykeben»)	☐	☐
Andre årsaker	☐	☐

Skriv hvilke årsaker her:

Ikke skriv i disse rutene

	JA	NEI
Jeg er usikker på årsaken	☐	☐

Hvilke kolesterolsenkende medisiner bruker du NÅ og hvilken dose bruker du?

Hvilke(t) merke(r) bruker du? — Samlet dose på ett døgn

mg

mg

mg

Ikke skriv i disse rutene

14. ETTERUNDERSØKELSE

Hvis denne helseundersøkelsen viser at du bør undersøkes nærmere, hvilken allmennpraktiserende lege/kommunelege ønsker du da å bli henvist til?
Oppgi legens navn:

Ikke skriv i disse rutene

15. TIL KVINNER SOM DELTAR I HELSEUNDERSØKELSEN

Hvor gammel var du da du fikk menstruasjon aller første gang? .... *Alder i år*

	JA	NEI
Har du for tiden regelmessig menstruasjon? *Regn den for regelmessig hvis den ikke har vært borte mer enn 3 mnd. sammenhengende siste år.*	☐	☐

Til deg som svarte JA: Omtrent hvor mange dager etter starten på siste menstruasjon skjer helseundersøkelsen? *(Sett bare ett kryss)*

Under 8 ☐ 8-14 ☐ 15-21 ☐ Mer enn 21 dager ☐

Hvis du for tiden ikke har regelmessig menstruasjon, ber vi deg fylle ut nedenfor *(Sett bare ett kryss)*

- Menstruasjonen sluttet av seg selv for minst 6 mnd. siden (overgangsalder) ☐ 1
- Menstruasjonen sluttet etter underlivsoperasjon, strålebehandling eller cellegift ☐ 2
- Usikker på om menstruasjonen har sluttet (mulig overgangsalder) ☐ 3
- Gravid i mindre enn 6 måneder ☐ 4
- Gravid i 6 måneder eller mer ☐ 5
- Har nylig født eller ammer, og har ikke fått menstruasjonen tilbake ☐ 6
- Helt uregelmessige menstruasjoner, med svært korte eller svært lange pauser ☐ 7
- Ingen eller uregelmessig menstruasjon på grunn av hormonbehandling ☐ 8
- Har aldri hatt menstruasjoner ☐ 9

Hvis du ikke lenger har menstruasjon, hvor gammel var du da den sluttet? .... *Alder i år*

Hvor mange barn (levende barn) har du født? *Antall barn*

Hvor lenge har du ammet dine barn til sammen? *(f.eks. 3 barn: 1 + 6 + 10 = 17 måneder)* .... *Antall mnd.*

Bruker du nå, eller har du tidligere brukt	Nå	Før, men ikke nå	Aldri
P-pille (*også minipille*) eller p-sprøyte	☐	☐	☐
Vanlig spiral	☐	☐	☐
Hormonspiral (pris ca. kr. 1000)	☐	☐	☐
Østrogen/progesteron (*tabletter, plaster, sprøyte*)	☐	☐	☐
Østrogen (*krem eller stikkpiller*)	☐	☐	☐

Til deg som bruker p-pille, hormonspiral (ikke vanlig spiral) eller hormoner i overgangsalderen NÅ:
Hvilke(t) merke(r) bruker du?

Ikke skriv i disse rutene

Omtrent hvor lenge har du brukt det du bruker nå?

Antall år — *Hvis mindre enn ett år: ..... Måneder*

Takk for utfyllingen!
Nok en gang:
Velkommen til undersøkelsen!

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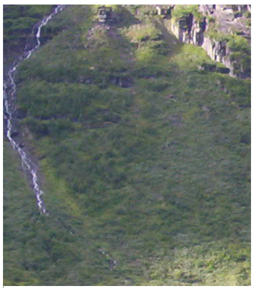
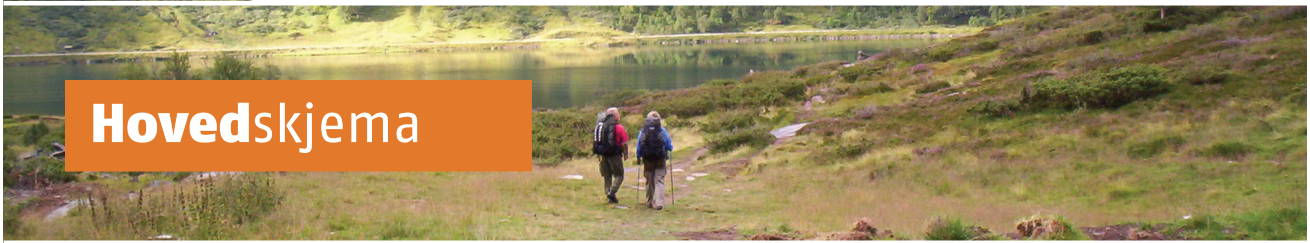


Kan1
Kartlegging aktivitet Norge



Hovedskjema

Kjære Kan1 deltaker,

Ved hjelp av besvarelsen fra deg og andre deltakere vil vi få økt kunnskap om det fysiske aktivitetsnivået i den norske befolkning. I tillegg vil vi få bedre forståelse for hvilke forhold som er knyttet til fysisk aktivitet blant voksne og eldre.

Du har selvsagt anledning til å unnlate å svare på enkeltspørsmål. Det er imidlertid viktig at du gir ærlige svar. Informasjonen i dette spørreskjemaet behandles konfidensielt og ditt navn vil verken forekomme i datafiler eller i skriftlig materiale.

Det tar 20-30 minutter å fylle ut spørreskjemaet.
Vennligst følg instruksene underveis.

Skjemaet skal leses ved hjelp av en datamaskin. Bruk sort eller blå penn ved utfylling. Det er viktig at du fyller ut skjemaet riktig:

- Ved avkrysning, sett ett kryss innenfor rammen av boksen ved det svaralternativet som passer best

X	Riktig
X	Galt
	Om du krysser av i feil boks, retter du ved å fylle boksen slik

- Skriv tydelige **tall** innenfor rammen av boksen

7 4	Riktig
7 4	Galt

- Bruk **blokkbokstaver** hvis du skal skrive A B C D E F

På forhånd takk for hjelpen!

T T

Bakgrunnsinformasjon

1) Kjønn: ☐ Kvinne ☐ Mann

2) Fødselsår: 19 ☐☐

3) Høyde: ☐☐☐ cm

4) Vekt: ☐☐☐, ☐ kg

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

- ☐ Mindre enn 7 år grunnskole
- ☐ Grunnskole 7-10 år, framhaldsskole eller folkehøgskole
- ☐ Realskole, middelskole, yrkesskole, 1-2 årig videregående skole
- ☐ Artium, økonomisk gymnas, allmennfaglig retning i videregående skole
- ☐ Høgskole/universitet, mindre enn 4 år
- ☐ Høgskole/universitet, 4 år eller mer

6) Hva er din hovedaktivitet? (Sett ett kryss)

☐ Yrkesaktiv heltid	☐ Hjemmeværende
☐ Yrkesaktiv deltid	☐ Pensjonist/trygdet
☐ Arbeidsledig	☐ Student/militærtjeneste

7) Hvor høy var husholdningens samlede bruttoinntekt siste år? (sett ett kryss)
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

T T

8) Hvor mange innbyggere er det i din bostedskommune? (sett ett kryss)

- ☐ Under 1000
- ☐ 1001 – 5000
- ☐ 5001 – 10.000
- ☐ 10.001 – 20.000
- ☐ 20.001 – 30.000
- ☐ 30.001 – 100.000
- ☐ Mer enn 100.000

9) Hvordan vurderer du din egen helse sånn i alminnelighet? (sett ett kryss)

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

10) I hvilken grad begrenser din helse dine hverdagslige gjøremål? (sett ett kryss)

☐ I stor grad ☐ I noen grad ☐ I liten grad ☐ Ikke i det hele tatt

11) Mener du at fysisk aktivitet er viktig for å kunne vedlikeholde egen helse?
(sett ett kryss)

- ☐ Ja, meget viktig for meg
- ☐ Egentlig tenker jeg ikke så mye på det
- ☐ Nei, det er ikke så viktig for meg

12) Har du, eller har hatt: (sett gjerne flere kryss)

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

T T

Fysisk aktivitet

De neste spørsmålene omhandler 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, svømming, dansing)
- trening (for å bedre kondisjon, muskelstyrke og andre ferdigheter)

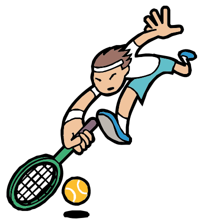
Det er flere nesten like spørsmål - det er meningen

13) Er du *aktivt medlem* av et idrettslag eller en idrettsklubb? (sett ett kryss)

☐ Ja

☐ Nei, men jeg har vært medlem før

☐ Nei, jeg har aldri vært medlem (gå til spm 15)



14) Når ble du medlem for første gang?

Jeg ble medlem da jeg var ☐☐ år gammel

15) Dersom du er fysisk aktiv, hvilke aktiviteter driver du vanligvis med:
(Sett gjerne flere kryss)

☐ Turgåing	☐ Ballspill	☐ Padling/roing
☐ Dans	☐ Stavgang	☐ Sykling/spinning
☐ Golf	☐ Svømming	☐ Jogging
☐ Langrenn	☐ Vanngymnastikk	☐ Skøyter/bandy/hockey
☐ Yoga/pilates	☐ Alpint/snowboard	☐ Trening til musikk i sal
☐ Tennis	☐ Kampsport (karate, judo ol)	☐ Squash/Badminton/Bordtennis

☐ Treningsstudio (styrketrening, tredemølle, ergometersykkel, elipsemaskin ol)

☐ Annet,

hva:____

T T

16) Hvor ofte trener du på de måtene som er nevnt under?
(Sett ett kryss for hvor ofte du er aktiv på hver måte)

	Aldri	Sjelden	1-3 g/mnd	1 dag/uke	2-3 dag/uke	4-6 dag/uke	Daglig
I idrettslag………………	☐	☐	☐	☐	☐	☐	☐
På treningssenter………	☐	☐	☐	☐	☐	☐	☐
På jobben eller skolen…	☐	☐	☐	☐	☐	☐	☐
Hjemme…………………	☐	☐	☐	☐	☐	☐	☐
I nærmiljøet……………..	☐	☐	☐	☐	☐	☐	☐
I svømmehall……………	☐	☐	☐	☐	☐	☐	☐
Sykler……………………	☐	☐	☐	☐	☐	☐	☐
Danser…………………....	☐	☐	☐	☐	☐	☐	☐
Skitur…………………….	☐	☐	☐	☐	☐	☐	☐
Fottur…………………….	☐	☐	☐	☐	☐	☐	☐

17) Hvor mange timer den siste uken har du vært i fysisk aktivitet i hjemmet eller i tilknytning til hjemmet? Det er kun aktiviteter som varer i minst 10 minutter i strekk som skal rapporteres

	Ingen	< 1 time	1-2 timer	3-4 timer	> 4 timer
Lett aktivitet - ikke svett/andpusten………..	☐	☐	☐	☐	☐
Hard aktivitet - svett/andpusten…………….	☐	☐	☐	☐	☐

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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 mm)… ☐
- 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……. ☐

Når du svarer på spørsmålene 19 - 22:

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 eller jogge i moderat tempo eller mosjonstennis? Ikke ta med gange, det kommer i neste spørsmål.

☐ Dager per uke

☐ Ingen (gå til spørsmål 21a)

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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

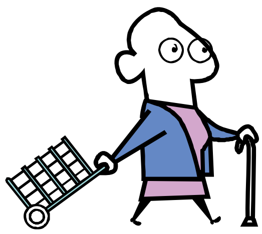
21a) Hvor mange dager i løpet av de siste 7 dager, *gikk du minst 10 minutter* i strekk for å komme deg fra ett sted til et annet? Dette inkluderer gange på jobb og hjemme, gange til buss, eller gange som du gjør på tur eller som trening i fritiden

☐ Dager per uke

☐ Ingen (gå til spørsmål 22)

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



22) Dette spørsmålet omfatter all tid du tilbringer i ro (*sittende*) på jobb, hjemme, på kurs, og på fritiden. Det kan være tiden du sitter ved et arbeidsbord, hos venner, mens du leser eller ligger for å se på TV.

I løpet av de siste 7 dager, hvor land tid brukte du vanligvis totalt på å sitte <u>på en vanlig hverdag</u>?

☐ Timer ☐ Minutter ☐ Vet ikke/husker ikke

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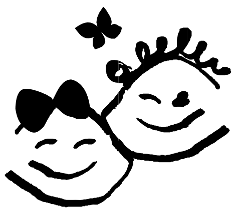
23) **Nedenfor følger en rekke grunner for å drive med fysisk aktivitet.** Vennligst sett ett eller flere kryss for den (de) grunnen(e) som er viktige for deg.

- ☐ 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



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

- ☐ Har ikke tid
- ☐ Har ikke råd
- ☐ Transportproblemer
- ☐ Negative erfaringer
- ☐ Bevegelsesproblemer
- ☐ Tror ikke jeg får det til
- ☐ Orker ikke
- ☐ Synes jeg er for gammel
- ☐ På grunn av min fysiske helse
- ☐ Har ingen å være fysisk aktiv sammen med
- ☐ Tidspunktet passer meg ikke
- ☐ Kjenner ikke til noe tilbud
- ☐ Engstelig for å gå ut
- ☐ Mangel på tilbud innen mine interesseområder
- ☐ Redd for å bli skadet (falle, forstue)
- ☐ Vil heller bruke tiden min til andre ting
- ☐ Andre grunner, hva: ____________________

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Transport aktiviteter

De neste spørsmålene handler om dine vaner knyttet til transport og omfatter dine vanlige måter å komme fra et sted til et annet, inkludert hvordan du kommer deg til og fra jobb, butikker, kino, fritidssysler og så videre.

Merk at du skal angi dine transportvaner separat for sommer og vinter.

25a) Hvor mange dager *i en vanlig uke* reiser du med et motorisert transportmiddel som tog, buss, bil eller trikk?

Om sommeren

☐ Dager per uke

Om vinteren

☐ Dager per uke

25b) På *en vanlig dag* hvor du reiser med motorisert transportmiddel, hvor lang tid bruker du da totalt i transportmiddelet?

Om sommeren

☐ Timer ☐ Minutter

Om vinteren

☐ Timer ☐ Minutter

26a) 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

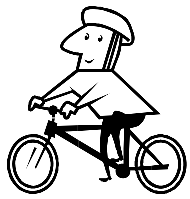
26b) På *en vanlig dag* hvor du *sykler* for å komme deg fra et sted til ett annet, hvor lang tid bruker du da totalt på å sykle?

Om sommeren

☐ Timer ☐ Minutter

Om vinteren

☐ Timer ☐ Minutter



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27a) Hvor mange dager i *en vanlig uke* går 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

27b) På *en vanlig dag* hvor du går for å komme deg fra et sted til ett annet, hvor lang tid bruker du da totalt på *å gå*?

Om sommeren

☐ Timer ☐ Minutter

Om vinteren

☐ Timer ☐ Minutter

28) Dersom du er yrkesaktiv, hvordan kommer du deg vanligvis til og fra arbeid?

☐ Bil/motorsykkel
☐ Offentlig transport (tog, buss, og liknende)
☐ Sykkel
☐ Til fots
☐ Ikke aktuelt

TV, PC og søvnvaner

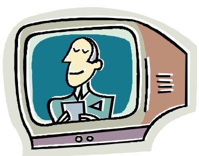
De neste spørsmålene handler om dine vaner knyttet til bruk av **TV og PC utenom jobb.** I tillegg vil vi kartlegge dine søvnvaner

29) Utenom jobb: Hvor mange timer ser du vanligvis på TV og sitter med PC på en hverdag? (Sett ett kryss)

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

30) Utenom jobb: Hvor mange timer ser du vanligvis på TV og sitter med PC på en helgedag? (Sett ett kryss)

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



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31) Hvor mange timer i døgnet sover du vanligvis på en hverdag?
(Sett ett kryss)

☐ Mindre enn 3 timer ☐ 8 - 10 timer

☐ 3 - 5 timer ☐ 10 timer eller mer

☐ 5 - 8 timer

32) Hvor mange timer i døgnet sover du vanligvis på en helgedag eller fridag?
(Sett ett kryss)

☐ Mindre enn 3 timer ☐ 8 - 10 timer

☐ 3 - 5 timer ☐ 10 timer eller mer

☐ 5 - 8 timer

Kosthold, røyk og alkohol

I denne delen av spørreskjemaet er det fokus på kosthold og dine røyke- og alkoholvaner. Vi er klar over at kostholdet varierer fra dag til dag. Prøv derfor så godt du klarer å ta ett gjennomsnitt av dine spisevaner og ha det siste året i tankene når du svarer.

33) Har du røykt/røyker du daglig? (sett ett kryss)

☐ Ja, nå ☐ Ja, tidligere ☐ Aldri (Gå videre til spørsmål 36)

34) Hvis du har røykt daglig tidligere, hvor lenge siden er det du sluttet?

☐ år

35) Hvis du røyker daglig nå eller har røykt tidligere:

Hvor mange sigaretter røyker eller røykte du vanligvis daglig?

☐ Antall sigaretter

Hvor gammel var du da du begynte å røyke?

☐ Alder i år

Hvor mange år til sammen har du røykt daglig?

☐ Antall år

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36) Bruker du snus? (sett ett kryss)

☐ Ja, daglig ☐ Av og til ☐ Aldri

37) Hvor ofte drikker du alkohol? (Sett ett kryss som stemmer best med dine vaner)

☐ Aldri

☐ Månedlig eller sjeldnere

☐ 2 - 4 ganger pr måned

☐ 2 - 3 ganger per uke

☐ 4 ganger i uken eller oftere

38) Når du drikker alkohol, hvor mange "drinker" tar du vanligvis?
En "drink" tilsvarer en ½ liter pils, ett glass vin, ett drammeglass
(Dersom du ikke drikker alkohol skal du ikke krysse)

☐ 1 - 2 ☐ 3 - 4 ☐ 5 - 6 ☐ 7 - 8 ☐ 9 eller mer

39) Hvor mange enheter med frukt og grønnsaker spiser du i gjennomsnitt hver dag?
(Med enhet menes for eksempel 1 frukt, 1 glass juice, 2-3 poteter, 1 skål bær, 1 porsjon grønnsaker, 1 porsjon salat)

☐☐ Antall porsjoner frukt

☐☐ Antall porsjoner grønnsaker

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

	Aldri/ Sjelden	**1 g/uke**	**2 g/uke**	**3 g/uke**	**4 g/uke**	**5 g/uke**	**6 g/uke**	**Hver dag**
Frokost.......	☐	☐	☐	☐	☐	☐	☐	☐
Lunsj..........	☐	☐	☐	☐	☐	☐	☐	☐
Middag.......	☐	☐	☐	☐	☐	☐	☐	☐
Kveldsmat...	☐	☐	☐	☐	☐	☐	☐	☐

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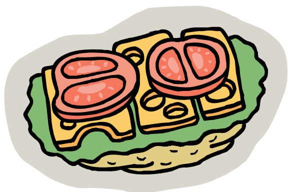
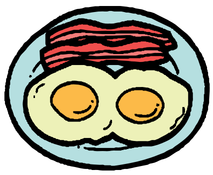
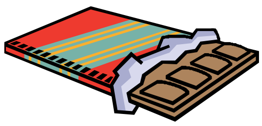
41) Hvor ofte spiser du vanligvis disse matvarene?
(Sett ett kryss per linje)

	0-1 g/mnd	2-3 g/mnd	1-3 g/uke	4-6 g/uke	1-2 g/dag
Poteter (kokte, stekte, potetmos)…………………..….	☐	☐	☐	☐	☐
Pasta/ris……………………………………………….	☐	☐	☐	☐	☐
Kjøtt (reint kjøtt av storfe, lam, svin, vilt)……………….	☐	☐	☐	☐	☐
Kvernet kjøtt (pølser, hamburger, kjøttdeig, kjøttkaker)	☐	☐	☐	☐	☐
Kylling………………………………………………….	☐	☐	☐	☐	☐
Grønnsaker (ikke poteter)………………………….....	☐	☐	☐	☐	☐
Frukt og bær……………………………………….	☐	☐	☐	☐	☐
Mager fisk (torsk, sei, ol)…………………………….	☐	☐	☐	☐	☐
Fet fisk (laks, ørret, makrell, sild, kveite, uer, ol)…….	☐	☐	☐	☐	☐
Grovt brød………………………………………………	☐	☐	☐	☐	☐
Salt snacks (potetgull, saltstenger, ol)………………	☐	☐	☐	☐	☐
Godteri/sjokolade…………………………………….	☐	☐	☐	☐	☐
Kaker/kjeks……………………………………………..	☐	☐	☐	☐	☐

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42) Hvor mye drikker du vanligvis av følgende? (Sett ett kryss for hver linje)

	Sjelden/ aldri	1-3 glass pr mnd	1-3 glass pr uke	4-6 glass pr uke	1-3 glass pr dag	4-6 glass pr dag	>7 glass pr dag
Helmelk…………	☐	☐	☐	☐	☐	☐	☐
Lettmelk…………	☐	☐	☐	☐	☐	☐	☐
Ekstra lett melk…	☐	☐	☐	☐	☐	☐	☐
Skummet melk…	☐	☐	☐	☐	☐	☐	☐
Juice……………...	☐	☐	☐	☐	☐	☐	☐
Vann………………	☐	☐	☐	☐	☐	☐	☐
Brus med sukker…	☐	☐	☐	☐	☐	☐	☐
Brus uten sukker…	☐	☐	☐	☐	☐	☐	☐
Kaffe………………	☐	☐	☐	☐	☐	☐	☐
Te…………………	☐	☐	☐	☐	☐	☐	☐
Pils………………	☐	☐	☐	☐	☐	☐	☐
Vin…………………	☐	☐	☐	☐	☐	☐	☐
Brennevin…………	☐	☐	☐	☐	☐	☐	☐

Holdninger til fysisk aktivitet

I denne siste delen er det fokus på dine holdninger til fysisk aktivitet. Du nærmer deg slutten av skjemaet. **Hold ut** ☺

43) 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
Jeg er trett………………………………	☐	☐	☐	☐	☐	☐	☐
Jeg føler meg nedtrykt…………………..	☐	☐	☐	☐	☐	☐	☐
Jeg er bekymret………………………….	☐	☐	☐	☐	☐	☐	☐
Jeg er sint på grunn av noe……………	☐	☐	☐	☐	☐	☐	☐
Jeg føler meg stresset…………………	☐	☐	☐	☐	☐	☐	☐

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44) Tenk på alle former for fysisk aktivitet. For hver påstand, angi i hvilken grad du er enig/uenig. (Sett ett kryss for hver påstand)

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

45) I hvilken grad beskriver disse påstandene deg som person?
(Sett ett kryss for hver påstand)

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

46) Har familien din (medlemmer i husstanden):
(Sett ett kryss for hver påstand)

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

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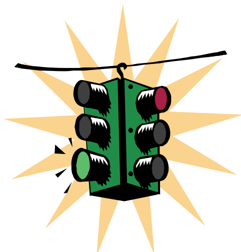
47) Har vennene dine/bekjente/familiemedlemmer utenfor husstanden:
(Sett ett kryss for hver påstand)

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

48) Er det i ditt nærmiljø:
(Sett ett kryss for hver påstand)

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



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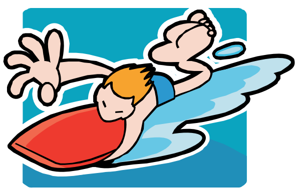
49) Omtrent hvor lang tid vil det ta deg å gå hjemmefra til:
(Sett ett kryss for hver linje)

	1-5 min	6-10 min	11-20 min	21-30 min	> 30 min	Vet ikke
Butikk for dagligvarer…………………	☐	☐	☐	☐	☐	☐
Et friområde/park/turvei………………	☐	☐	☐	☐	☐	☐
Helsestudio/treningssenter/svømme-hall/idrettshall/utendørs idrettsanlegg	☐	☐	☐	☐	☐	☐
Skog/mark/fjell…………………………	☐	☐	☐	☐	☐	☐

50) I hvilken utstrekning mener du at daglig fysisk aktivitet kan ha gunstig effekt for å forebygge følgende sykdommer: (Sett ett kryss for hver linje)

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



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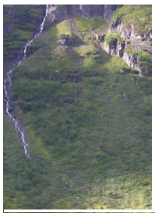
Omslag 4 15-04-08 14:45 Side 4

Etter at du har fylt ut spørreskjemaet og gått med aktivitetsmåleren i 7 dager, legger du skjemaet og aktivitetsmåleren i den vedlagte konvolutten og returnerer den til oss.

Tusen takk for hjelpen



Kan 1

kartlegging **aktivitet** Norge

2008

Kan 1
Kartlegging aktivitet Norge

Tilleggsskjema

Informasjon om måleperioden

Dette tilleggsskjemaet fylles ut etter at du har gått med aktivitetsmåleren i sju dager.

1) Beskriv i hovedtrekk hvordan været og underlaget var i de sju dagene du gikk med aktivitetsmåleren:

	VÆRET			UNDERLAGET		
	Opphold	**Skiftende**	**Nedbør**	**Isete**	**Vått/sølete**	**Tørt**
Dag 1	☐	☐	☐	☐	☐	☐
Dag 2	☐	☐	☐	☐	☐	☐
Dag 3	☐	☐	☐	☐	☐	☐
Dag 4	☐	☐	☐	☐	☐	☐
Dag 5	☐	☐	☐	☐	☐	☐
Dag 6	☐	☐	☐	☐	☐	☐
Dag 7	☐	☐	☐	☐	☐	☐

2a) Hvor mange dager i måleperioden har du tatt av deg aktivitetsmåleren for å drive med svømming?

☐ Dager ☐ Ingen (gå videre til spm 3)

2b) På en dag hvor du drev med svømming, hvor lenge varte aktiviteten i gjennomsnitt?

☐ Timer ☐ Minutter ☐ Vet ikke/husker ikke

3a) Hvor mange dager i måleperioden har du syklet eller drevet med spinning/ergometersykkel?

☐ Dager ☐ Ingen (hopp over siste spørsmål)

3b) På en dag hvor du syklet, hvor lenge varte aktiviteten i gjennomsnitt?

☐ Timer ☐ Minutter ☐ Vet ikke/husker ikke

Appendix IV:

Instructions to use of the activity monitor

Bruk av aktivitetsmålaren

Ta på deg aktivitetsmålaren **morgonen etter** at du mottok han i posten. Målaren skal sitje på **i sju heile dagar,** frå du står opp til du legg deg. Du treng ikkje slå han av eller på, alt går automatisk.

Ta på deg målaren slik:

- Fest beltet rundt livet slik at målaren sit på **høgre hoftekam** (sjå bilde). Det er viktig at du er nøyaktig med plasseringa av målaren
- Pass på at sida merkt med "Opp" peikar oppover
- Målaren skal vere godt fest og ikkje henge og slenge

Det er berre i desse situasjonane at målaren **ikkje** skal sitje på:

- Når du søv (om natta)
- Når du dusjar, sym eller badar (han er ikkje vasstett)

Målaren tåler dagleg bruk, og du treng ikkje vere redd for at han skal gå sund. Målaren må likevel ikkje opnast, vaskast eller lånast bort. Gå med målaren både til kvardag og til fest, dersom han sjenerer, kan du gøyme han under kleda. Målaren kostar 2500 kr. Du er ikkje økonomisk ansvarleg for målaren, men pass godt på han. Returner målaren i vedlagd returkonvolutt (saman med Hoved- og Tilleggsskjema) etter at du har gått med han i sju dagar.

Sjå www.nih.no/kan for meir info og videosnutt