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Physical activity, cardiovascular risk factors, and mortality in ethnic groups in the Arctic region of Norway

Results from two population-based studies: The Finnmark 3 study 1987-1988 and SAMINOR 1 2003-2004

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PHYSICAL ACTIVITY, CARDIOVASCULAR RISK FACTORS, AND MORTALITY IN ETHNIC GROUPS IN THE ARCTIC REGION OF NORWAY

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Polar Night
Photo: Rune Hermansen

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Preface/Acknowledgements

Working as general practitioner in the 1990´s in Sámi core area of Finnmark gave me the idea to this PhD thesis. I was fascinated by the traditional Sámi way of living and wondered if this could yield health benefits compared to society at large.

With great support from the Department of Community Medicine (ISM) at UiT The Arctic University of Norway and funding by "Medisinsk forskning i Finnmark", a public fund, I started the long way of working on my thesis, with the first article published in 2002. Short time after this, the special funding for Finnmark ceased and my project was put on hold.

I resumed the project as a PhD candidate in 50% position from 01.02.2014 with guidance from ISM and funding provided by scholarship from Finnmark Hospital Health Trust.

Doing most of the research from my home office in Vadsø has been a demanding but also rewarding process. I want to express my gratitude to Finnmark Hospital Health Trust for the opportunity to doing research and good will. Furthermore, a special thanks to my main supervisor, Bente Morseth, for your patience, guidance and availability. You are always kind, positive and helpful.

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Looking back to the very beginning of my interest for research, I want to express my gratitude to Vinjar Fønnebø, who was the main supervisor on my very first paper as 5th year medical student and later a co-author on my first manuscript of the thesis. You have inspired me both during co-authorship and excellent lectures in medical school and seminars. Furthermore, thanks for your friendship and interesting conversations when we stayed in Tromsø.

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Finally, I want to express my deepest gratitude to my family. My dear dad who died last summer, who taught me to believe that you can become whatever you want. Thanks for your love and kindness. My mother, who was my greatest supporter in sports and companion when I was introduced to cross-country skiing. You are forgiven that you accidently broke my first pair of skis when I was tree years old. My dearest wife Anita, you have always been supportive and given me freedom to go for my dreams. You are my rock in life. When I was at work at Kirkenes hospital you took care of our house, snow-shovelling in wintertime and waited patiently for me to come home for weekends. I admire what you are – thanks….

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List of abbreviations

ANCOVA	Analysis of covariance
BMI	Body mass index
CI	Confidence interval
CHD	Coronary heart disease
CVD	Cardiovascular disease
DBP	Diastolic blood pressure
GBD	Global Burden of Disease
HDL-C	High-density lipoprotein cholesterol
HR	Hazard ratio
ICD	International Classification of Diseases
LDL-C	Low-density lipoprotein cholesterol
LTPA	Leisure time physical activity
MET	Metabolic equivalents
MI	Myocardial infarction
OPA	Occupational physical activity
PAR	Population attributable risk
RCT	Randomized controlled trial
RHR	Resting heart rate
SBP	Systolic blood pressure
SES	Socio-economic status
WHO	World Health Organization

List of papers

The thesis is based on the following papers:

I. Hermansen R, Njølstad I, Fønnebø V. Physical activity according to ethnic origin in Finnmark County, Norway. The Finnmark study. Int J Circumpolar Health. 2002;61(3):189-200.

II. Hermansen R, Broderstad AR, Jacobsen BK, Mähönen M, Wilsgaard T, Morseth B. The impact of changes in leisure time physical activity on changes in cardiovascular risk factors: results from The Finnmark 3 study and SAMINOR 1, 1987-2003. Int J Circumpolar Health. 2018;77(1):1459145.

III. Hermansen R, Jacobsen BK, Løchen ML, Morseth B. Leisure Time and Occupational Physical Activity, Resting heart rate, and Mortality in the Arctic region of Norway. The Finnmark Study. Eur J Prev Cardiol. 2019;26(15):1636-1644.

Abstract

Worldwide, cardiovascular disease (CVD) is a major cause of premature mortality and focus on preventive factors is warranted. Although the beneficial health effects of physical activity are well documented, little is known about the association between physical activity, CVD risk factors and mortality among indigenous people such as the Sámi, who are living in demanding climatic conditions in the Arctic of Norway. Historically, the multi-ethnic population in this region had the highest incidence of CVD and premature death in Norway. The life expectancy is still somewhat shorter than the average in Norway.

The objective of this thesis was to provide new insight into physical activity, CVD risk factors and mortality in relation to ethnicity in the Arctic of Norway. The first aim was to examine physical activity levels and the interpretation of the concept of physical activity in ethnic groups (paper 1). The second aim was to examine the impact of changes in leisure time physical activity (LTPA) on changes in CVD risk factors in ethnic groups (paper II). Finally, we examined the association of LTPA, occupational physical activity (OPA), and resting heart rate (RHR) with mortality (paper III).

This thesis builds on two population-based studies; the Finnmark Study 3 in 1987-1988 and SAMINOR 1 in 2003-2004. Paper I is a cross-sectional study, whereas paper II and III are prospective cohort studies with 16 and 26 years of follow-up, respectively.

The main finding from paper I was that Sámi men and women were more physically active at work and thus had a higher total physical activity score than Norwegian men and women. The qualitative part of the study indicated that Sámi living as reindeer herdsmen and farmers in both ethnic groups did not clearly differentiate between work and leisure time activity. This could potentially influence the way they interpreted questions about physical activity. Paper II, addressing changes in LTPA in relation to changes in CVD risk factors, showed only small effects of LTPA on CVD risk factors, although favourable changes in body mass index (BMI) and levels of triglycerides were most pronounced in those who were physically active at both surveys. The associations were similar in Sámi and non-Sámi. In paper III, which was based on a prospective study over 26 years, LTPA was inversely, linearly associated with all-cause mortality, but not CVD mortality. We observed a U-shaped association between OPA and CVD and all-cause mortality. Furthermore, we found that mortality increased with increasing RHR. The association of LTPA, OPA, and RHR with mortality was similar between the two ethnic groups.

In conclusion, we found no differences between Sámi and non-Sámi regarding the associations between physical activity and cardiovascular risk factors or mortality, although the Sámi were more physically active at baseline. Overall, there were surprisingly few and only modest associations between changes in LTPA and changes in cardiovascular risk factors. The association between LTPA and mortality was inverse related, whereas the association between OPA and mortality showed a U-shape, indicating that higher levels of OPA may not decrease mortality. The findings may be of interest for an ethnic diverse population with a lifestyle closely interwoven with physical activity.

Sammendrag

På verdensbasis er hjerte-og karsykdommer en av hovedårsakene til for tidlig død og fokus på forebyggende tiltak er viktig. Selv om det er god dokumentasjon for de mange positive helseeffektene av fysisk aktivitet, er det mangelfull kunnskap om sammenhengen mellom fysisk aktivitet, risikofaktorer for hjerte-og karsykdom og død hos urfolk som eksempelvis samer, som lever under krevende klimatiske forhold i den arktiske delen av Norge. Historisk har den multietniske befolkningen i nord hatt landets høyeste forekomst av hjerte-og karsykdom og tidlig død. Forventet levealder i Finnmark er fortsatt noe lavere enn landsgjennomsnittet.

Formålet med denne avhandlingen var å tilføre ny kunnskap om forskjellige aspekter ved fysisk aktivitet og risikofaktorer for hjerte-og karsykdom og død i ulike etniske grupper i den arktiske delen av Norge. Det første målet var å studere nivået av fysisk aktivitet og hvordan etniske grupper i Finnmark har rapportert denne aktiviteten (artikkel I). Videre har vi undersøkt hvordan endring i fysisk aktivitet i fritid kan påvirke endringer i risikofaktorer for hjerte-og karsykdom i etniske grupper (artikkel II). I siste artikkel (artikkel III) har vi sett på sammenhengen mellom fysisk aktivitet i jobb og fritid, hvilepuls og dødelighet.

Avhandlingen bygger på to befolkningsundersøkelser som ble gjort i 1987–1988 (Finnmark 3) og SAMINOR 1 fra 2003–2004. Artikkel I hadde et tverrsnittsdesign, mens artikkel II og III var prospektive kohortstudier med henholdsvis 16 og 26 års oppfølgingstid.

Hovedfunnet i artikkel I var at samiske menn og kvinner var mer fysisk aktive i jobb, som bidro til at de totalt sett hadde en høyere fysisk aktivitetsscore enn norske menn og kvinner. Den kvalitative delen av studiet indikerte at samiske reindriftsutøvere og bønder i begge etniske grupper ikke skilte klart mellom jobb og fritid. Dette kan ha påvirket måten de oppfattet og besvarte spørsmål om fysisk aktivitet.

I artikkel II så vi på endring i fysisk aktivitet i fritid og endringer i risikofaktorer for hjerte-og karsykdom. Vi fant liten effekt av endringer av fysisk aktivitet på risikofaktorer, men de som var fysisk aktive ved begge målepunkter (1987–1988 og 2003–2004) hadde den mest gunstige utviklingen i kroppsmasseindeks og triglyserider. Denne sammenhengen var lik hos samer og ikke-samer. I artikkel III, som var en prospektiv oppfølgingsstudie over 26 år, fant vi en lineær og invers sammenheng mellom fritidsaktivitet og totaldødelighet, men ikke hjerte-og kardødelighet. Det var en U-formet relasjon mellom fysisk aktivitet i jobb og dødelighet, både totalt og av hjerte-og karsykdom. Videre fant vi at økende hvilepuls var assosiert med høyere dødelighet. Sammenhengen mellom fysisk

aktivitet i jobb og fritid og dødelighet, samt hvilepuls og dødelighet, var den samme i de to etniske gruppene.

Oppsummert har vi observert at selv om samer totalt sett var mer fysisk aktive ved oppstart av undersøkelsen, så fant vi ikke signifikante forskjeller mellom samer og ikke-samer når det gjelder sammenhengen mellom fysisk aktivitet og risikofaktorer for hjerte-og karsykdom eller død. Det var overraskende få og relativt beskjedne sammenhenger mellom endring i fysisk aktivitet og endringer i risikofaktorer for hjerte-og karsykdom. Det var en invers relasjon mellom fritidsaktivitet og dødelighet, mens relasjonen mellom jobbaktivitet og dødelighet var U-formet. Dette kan indikere at høyt fysisk aktivitetsnivå på jobb ikke beskytter mot for tidlig død. Våre funn kan være av interesse for multietniske populasjoner hvor fysisk aktivitet i større grad er knyttet opp mot øvrig livsstil.

1 Introduction

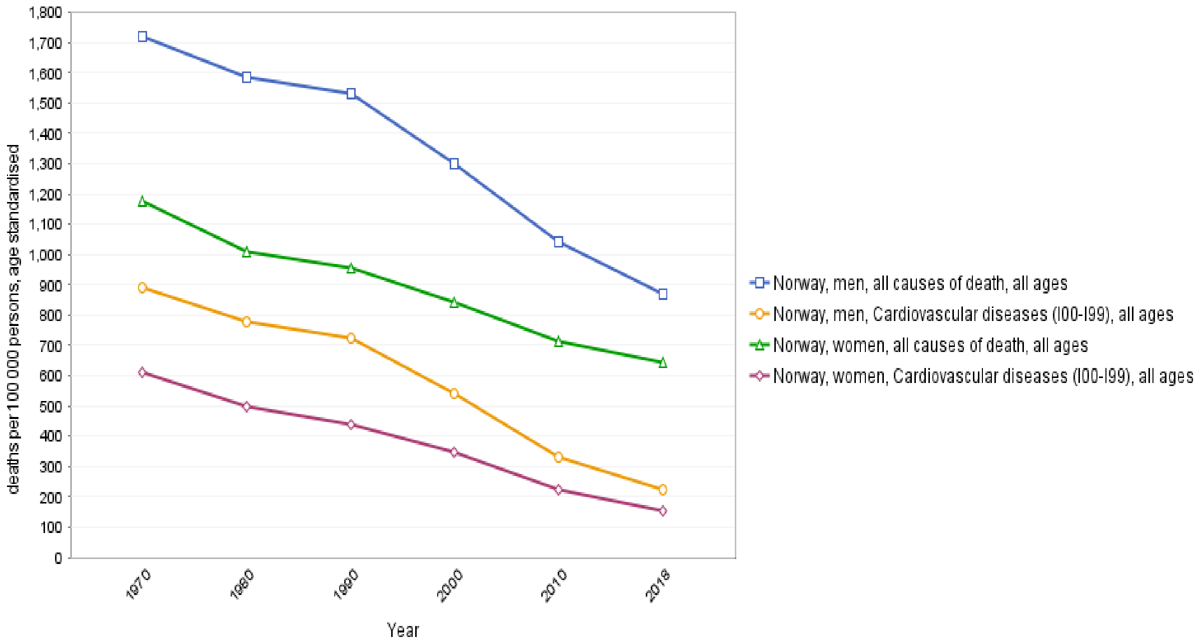
1.1 Demographics

This thesis builds on population-based health studies in Finnmark county, the northernmost county in Norway, which constitutes the Arctic region of Norway. A mixed ethnic population of Sámi, Norwegian and Finnish descents are living in this area and ethnicity is an important perspective of the thesis. Finnmark county is a part of Sápmi, a region with ancient Sámi settlement and still residence of the indigenous Sámi people. Sápmi covers the northern and middle parts of Norway, Sweden, Finland and Russia´s Kola Peninsula, with the largest proportion of the Sámi population living in Norway. There are still deficiencies in demographic information on the Sámi population, with no existing reliable or updated records showing Sámi affiliation (1). The culture and language of the Sámi traditionally differ from the society at large. For example, a relatively high proportion of the Sámi have been involved in agriculture and reindeer herding (2, 3), with harvesting from nature and use of natural local resources for living as an essential part of their lifestyle. Such a lifestyle could potentially contribute to higher levels of physical activity and reduction in cardiovascular disease (CVD) risk factors and mortality.

1.2 Epidemiology of CVD and mortality

Even though the incidence of CVD has decreased over several decades in most European countries (4, 5), CVD is still a major contributor to premature death, causing more than 17 million estimated deaths worldwide. According to the 2013 Global Burden of Disease (GBD) study (5), the proportion of CVD deaths constitutes approximately 31% of all deaths and 45% of all non-communicable deaths, which is twice the proportion of deaths caused by cancer, and the relative proportion of CVD deaths has increased since the 1990´s (5).

In Norway, the mortality from CVD has declined since the 1970´s (Figure 1), and mortality from myocardial infarction (MI) and ischemic heart diseases declined by 50% from 2000 to 2016 (6). Moreover, the incidence of MI has decreased by approximately 30% from 2001 to 2014 (6). Results from the Tromsø study support the nationwide findings, showing that the incidence of coronary heart disease (CHD) declined from 1995 to 2010 (7). This positive trend was mainly explained by favourable changes in cholesterol, reduction in blood pressure and smoking, and increased physical activity (7). However, as the number of elderly is increasing, the total number living with CVD is expected to increase in the future. Currently, approximately one fifth of the population is living with or at high risk of developing CVD (6). Thus, preventive measures such as physical activity should be emphasized.

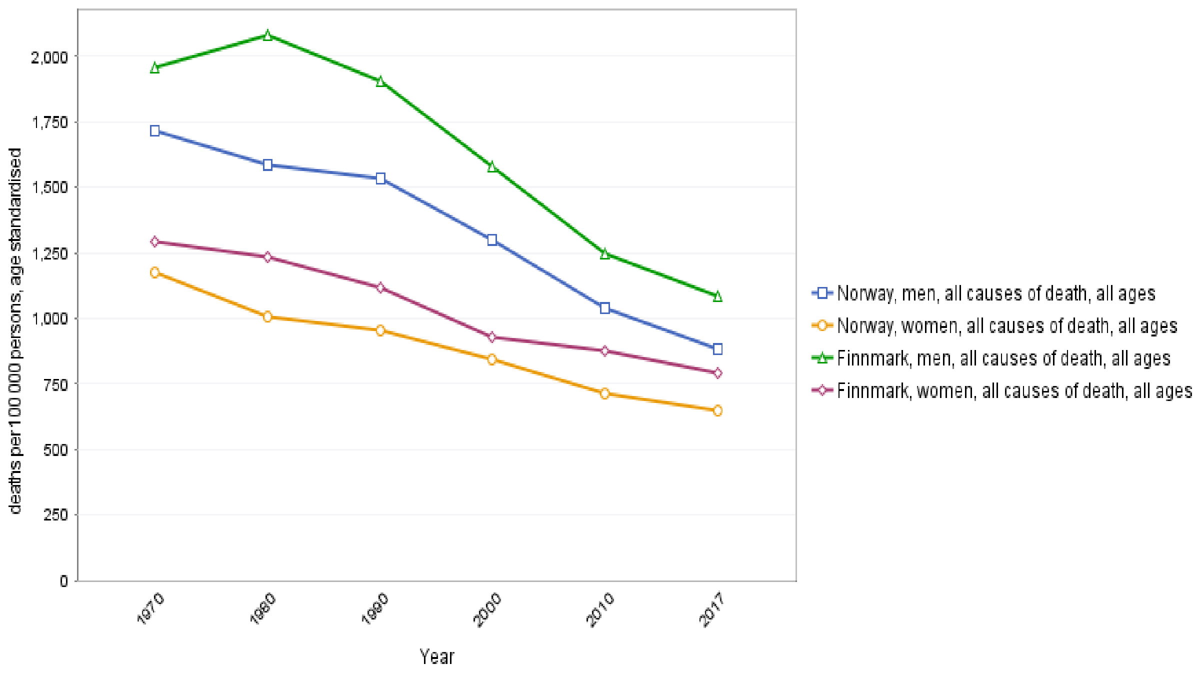


Source: norgeshelsa.no

Figure 1. All-cause and CVD mortality in Norway (deaths per 100.000 persons, age-standardised)

1.2.1 Historical perspective on the epidemiology of CVD and mortality in Finnmark

Historically, Finnmark county has had the highest mortality and incidence of CVD in Norway (8) (Figure 2). Forsdahl (9) hypothesized that poor living conditions in childhood and adolescence followed by prosperity could lead to increased risk of arteriosclerotic heart disease. Finnmark county had the highest infant mortality rates in Norway from 1876 – 1955 and the highest all-cause mortality over the same time period (8). The life expectancy in Finnmark is still somewhat shorter than the average in Norway for both men and women, but the gap is slowly decreasing (10). Compared to the county with highest life expectancy (for women: Møre og Romsdal; for men: Akershus) the difference was 2.2 years for women and 2.5 years for men, in 2015.



Source: norgeshelsa.no

Figure 2. All-cause mortality in Norway and Finnmark (deaths per 100.000 persons, age-standardised)

Results from a cohort study with 15 years of follow-up based on the two first cardiovascular screenings in Finnmark in 1974-1975 (Finnmark 1) and 1977-1978 (Finnmark 2), showed that Sámi men had lower mortality from coronary heart disease (CHD) and CVD, compared to Norwegian men (11). Furthermore, Sámi men had the lowest prevalence of CVD, diabetes and symptoms of angina pectoris (11). The differences in mortality could not be explained by traditional risk factors and the author speculated if genetic differences could favour the Sámi (11). A cohort study on MI incidence in ethnic groups from the same cohort in 1974-1975, followed for 14 years, did not support these findings, showing only minor differences in MI between the two ethnic groups (12). Thus, the issue of possible ethnic differences in mortality and CVD is still conflicting.

The people in Finnmark are living under harsh climate conditions with a long winter and a couple of months of Polar Nights. These external conditions make an interesting framework when exploring physical activity in relation to CVD risk factors and mortality. Around the globe, there are indications of seasonal variation in CVD with a peak during colder wintertime (13, 14). Increased morbidity and mortality from acute MI during autumn and winter have been reported in numerous studies, including in the Tromsø Study (13, 15, 16). One proposed explanation is circannual variation in blood pressure, vasoconstriction, plasma cortisol and catecholamines, platelet aggregability etc. (13). In addition, physical demanding tasks such as snow-shovelling could precipitate MI, especially among pre-disposed individuals (17). This kind of activity causes increased heart rate and systolic blood pressure. Furthermore, increased activation of platelet and fibrinogen and increased blood viscosity, have been associated with strenuous physical activity in the cold. An acute cardiac event could potentially be triggered by a combination of these factors in vulnerable individuals (17).

1.3 Epidemiology of CVD risk factors

According to WHO (18), the most important risk factors for CVD are tobacco smoking, physical inactivity, unhealthy diet, harmful use of alcohol, and obesity. Most of these elements are incorporated in the 2019 ACC/AHA guideline on the primary prevention of CVD (19). In Norway, the main contributors to the decline in mortality from MI and other ischemic heart diseases are favourable changes in risk factors such as smoking, cholesterol level and blood pressure (6, 7).

Compared to other counties in Norway, the population in Finnmark has proved less beneficial levels of CVD risk factors, including lower levels of physical activity (20).

1.3.1 The Sámi lifestyle and cardiovascular risk factors

Historically, there have been major lifestyle differences between Sámi and Norwegians. A higher proportion of Sámi were engaged in primary activities such as agriculture and reindeer industry. In the 1980´s the percentage was approximately 20% among Sámi vs. 8 % in the society at large (2). In the period from 1990 to 2008, the number of employees in the reindeer industry decreased by 16% (21), indicating that the differences diminish.

Further back in time, many Sámi lived as nomads, moving with their herds, and this lifestyle generated hard manual labour. Since the 1960´s the reindeer industry and farming have become increasingly motorized. Today, ATV´s, snowmobiles and helicopters are commonly used equipment among Sámi herdsmen. One of the research questions in this thesis is whether there could be different levels of self-reported physical activity between Sámi and non-Sámi and how questions about physical activity were interpreted.

In the early 1990s, in the Sámi core areas, the diet among Sámi differed compared to the general population (22). Traditionally, inland Sámi consumed more meat, especially from reindeer, and less fruits and vegetables (22). In a study from the Sámi region of Finland amongst reindeer herdsmen (23), CHD mortality in the Sámi area was lower than in the reference area. In addition, the researchers found higher levels of serum selenium, an indicator of fish consumption, among the Sámi than the Finns. Furthermore, the consumption of reindeer meat correlated with the serum concentration of alpha-tocopherol (an antioxidant). The authors hypothesized that higher alpha-tocopherol and selenium intake may become beneficial in terms of lower CHD mortality in the Sámi area (23).

Despite differences in lifestyle such as work conditions and diet, there seems to be only minor differences in CVD risk factors between Sámi and non-Sámi from the beginning of the screening program in the 70's to the early 2000 (11, 12, 24-26). Results from the first screening in Finnmark County in 1974-75 revealed only small differences in risk factors as blood lipids, blood pressure and smoking habits between Sámi and Norwegian men (12). In women, blood lipids, blood pressure, and incidence of diabetes mellitus were fairly similar, although Sámi women had a higher body mass index (BMI) than Norwegian women (12). Results from The SAMINOR II study conducted in 2012-2014 show that CVD risk factors as blood lipids, blood pressure and smoking habits still differ only slightly between Sámi and non-Sámi population. Furthermore, the estimated 10-year risk of acute MI and cerebral stroke was similar in the two ethnic groups (26). The multifaceted relations between lifestyle, including physical activity, CVD risk factors, and mortality in the multi-ethnic Arctic population inspired us to explore this relation further among the indigenous Sámi population as compared to the non-Sámi population.

1.4 Physical activity and modifiable CVD risk factors

According to the INTERHEART study including participants from 52 countries (27), nine factors accounted for 90% of the population attributable risk (PAR) of MI in men and 94% in women. These factors were smoking, hypertension, diabetes, dyslipidaemia, abdominal obesity, psychosocial factors, diet, alcohol consumption and physical inactivity. Physical inactivity alone contributed with a PAR of 12.2%. Physical inactivity is associated with most of these risk factors and may act through some of them, such as hypertension and obesity, to increase the risk of CVD and mortality (28-31).

Increased physical activity has been suggested as a lifestyle intervention in patients with essential hypertension as a part of antihypertensive treatment. In a meta-analysis of randomized controlled trials (RCTs), Semlitsch et al. (30) investigated the long term effects of physical activity interventions with the aim to increase physical activity on patients with essential hypertension. Compared with patients without intervention, the majority of RCTs revealed that increased physical activity decreased systolic blood pressure (SBP) by 5-10 mmHg and diastolic blood pressure (DBP) by 1-6 mmHg. This reduction in blood-pressure is comparable to the effects of sodium reduction (32) and weight reduction (33), but less potent than the effects of anti-hypertensive medication (34, 35).

Although physical activity seems to have beneficial effects in hypertensive patients, a better understanding of preventive effects of physical activity on hypertension and particularly in different ethnicities is warranted (36).

Since 1980 obesity has almost doubled worldwide, and in 2014, 11% of men and 15% of women were obese (37). Obesity has multiple negative consequences on health with increased risk of type 2 diabetes (38), CHD and stroke (39) and mortality (40), among others. This development is of great public health concern. Regular physical activity is one of the recommend strategies to manage overweight and obesity. In a review of RCTs by Thorogood et al. (31), the authors evaluated the effects of intervention with aerobic exercise program of 6-12 months in overweight and obese populations. Moderate-intensity exercise generated only modest reduction in weight and waist circumference, likewise modest improvement in CVD risk and lipid levels. The association between physical activity and obesity seems complex and is highly dependent on energy intake. Moreover, the understanding of the association between physical activity and overweight in different ethnic groups is of interest in view of the distinctive Sámi lifestyle.

High levels of HDL-C seem to be an independent predictor of cardiovascular events (41), and many studies have shown that aerobic exercise has favourable impact on blood lipids (42). Especially HDL-cholesterol (HDL-C) seems to be sensitive to aerobic exercise, compared to LDL-cholesterol (LDL-C) and triglycerides. However, there is a lack of understanding of this issue in relation to ethnicity.

1.5 Physical activity and mortality

It is well established that regular physical activity contributes to reduced risk of CVD (43) and premature death (29, 44, 45). Research on the association between physical activity and heart disease dates back to the 1950`s, when Morris et al. (46) found that drivers in London Transport Executive had higher risk of coronary artery disease and death compared to the more physically active conductors who walked the stairs in buses and trams. The Physical Activity Guidelines (47) recommends at least 150 min/week of moderate aerobic physical activity to reduce the risk of heart disease, stroke, hypertension, type 2 diabetes, excessive weight gain, depression, traumatic falls among elderly and many types of cancer. There are indications of further health benefits of increased activity above these 150 min/week (44). The physiological mechanisms that contribute to health benefits are many (48, 49), and include favourable metabolic changes, improved neurologic coordination, increased stroke volume and improved myocardial perfusion, reduced peripheral vascular resistance, and improved muscle and bone strength. In addition, physical activity might be favourable in losing weight, reducing blood pressure, favourable alterations of blood lipids and delay in the onset of type 2 diabetes (48).

1.5.1 Leisure time physical activity and mortality

Numerous studies have shown protective effects of regular physical activity on the risk of CVD and all-cause mortality (29, 44, 45, 50-54), and there is a strong association between persistent physical activity and risk reduction in mortality, with a dose-response relationship (44). For example, Moore et al. (52) showed that increasing levels of moderate to vigorous leisure-time physical activity (LTPA) were associated with greater gain in life expectancy, using pooled data from six prospective studies comprising more than 650000 participants. At the highest level of LTPA (22.5+ MET-h/week) corresponding to brisk walking for 450+ min/week, the gain was 4.5 years, compared to no LTPA. In a recent meta-analysis, Ekelund et al. (50) showed that increasing levels of accelerometry-measured physical activity resulted in reduced mortality, with a curve-linear dose-response relationship. The study showed larger effects of physical activity than studies based on self-reported physical activity, with the greatest risk reduction at 24 min/day of moderate-vigorous physical activity. Additional studies and meta-analyses support these findings, showing compelling evidence of the beneficial effects of persistent LTPA on the cardiovascular system and mortality. However, there are few studies from the Arctic region, and the association between physical activity and mortality in a diverse ethnic population living under demanding climate conditions is less studied.

1.5.2 Occupational physical activity and mortality

Findings on the association between occupational physical activity (OPA) and mortality are more conflicting and less explored. High levels of OPA are in some studies associated with increased mortality (55, 56), especially among men, whereas in other studies associated with decreased mortality (57, 58). In a meta-analysis with data from 17 studies, Coenen et al. (59) found that men, but not women, with high levels of OPA had an 18% higher mortality compared to low levels of OPA. Similar results were found in two longitudinal studies in Switzerland (60), indicating a higher total and CVD mortality among men with higher OPA compared to those with low OPA.

Holtermann et al. (61) have suggested a hypothesis for the less beneficial effects of OPA on cardiovascular health compared to LTPA, by introducing a “physical activity paradox”, indicating that while LTPA seems unanimously beneficial for mortality, high OPA may actually increase mortality. Possible explanations for the less beneficial effects of OPA include the distinct characteristics of OPA, such as low intensity, long duration, static postures, and heavy lifting (61). In addition, OPA may elevate 24-hour heart rate and blood pressure (61). The nature of OPA among the Sámi may be different from Norwegians, and ethnic and cultural differences could influence their perception of physical activity. Thus, the association between OPA and mortality is of interest both in general, and in relation to ethnicity, particularly in light of the ethnic differences in lifestyle and work conditions.

1.6 Ethnicity in the arctic region of Norway

Definition of ethnicity is complex. The word derives from the Greek word *ethnos* and means "people" or ethnic group (62). The term "ethnic minorities" is by Norwegian authorities restricted to include national minority, immigrants and indigenous people (63). The ILO Convention from 1989 (No. 169) (64) concerning Indigenous and Tribal peoples in Independent Countries defines indigenous people as follows in Article 1.1 : "*Peoples in independent countries who are regarded as indigenous on account of their descent from the populations which inhabited the country, or a geographical region to which the country belongs, at the time of conquest or colonization or the establishment of present state boundaries and who, irrespective of their legal status, retain some or all of their own social, economic, cultural and political institutions*". In Norway, the ILO Convention (No. 169) was ratified in 1990 and the Sámi was acknowledged by Norwegian State as the indigenous people of Norway (63, 64).

1.6.1 Ethics in ethnicity research

In the past, cranial indices and skull measurements were used to distinguish ethnic groups, including the Sámi (65). This example has been perceived discriminatory and racist, causing distrust to researchers. The lack of ethical considerations and sensitivity in the past is striking, and today there is more awareness of these issues. The Sámi Parliament decided in 2016 to provide ethical guidelines for Sámi health research. In 2017, a committee compiled a proposal for ethical guidelines for Sámi health research and research on human biological material (65), stating "*The guidelines are intended to ensure that research on the Sámi population and local Sámi communities, or their biological material, takes into account and respects the diversity and distinctive character that distinguishes Sámi culture and the Sámi communities, and ensures full equality and reciprocity throughout the research process".*

The committee suggests that collective consent must be obtained for all research on Sámi communities or people. In addition, the committee emphasize that: *"Sámi ethnicity shall be recognized and acknowledged in a culturally safe and responsible manner that preserves Sámi values and the standards associated with Sámi affiliation".* Ethical guidelines for Sámi health research in Norway (65) was approved by the Sámi Parliament in 2019. These guidelines are now incorporated by The Regional Committee for Medical Research Ethics in Northern Norway.

1.7 Rationale for the thesis

For more than a century, serious health issues among the people living in the Arctic of Norway have been reported, including high infant mortality, shorter life expectancy and higher risk of CVD and mortality than the general Norwegian population. There are knowledge gaps related to both physical activity and cardiovascular health in this mixed ethnic population, which inspired the study of physical activity and interpretation of the concept of physical activity (paper I). Paper I showing higher physical activity levels among the Sámi inspired study II, which was designed to examine changes in physical activity in relation to changes in CVD risk factors in a multi-ethnic population (paper II), and study III, addressing the association between physical activity and mortality (paper III).

1.8 Aims of the thesis

- Aim 1 was to examine potential ethnic differences in self-reported physical activity levels, and the distribution of RHR and BMI across levels of physical activity, in Sámi and Norwegian populations. Furthermore, we aimed to examine potential differences in the interpretations of the physical activity questionnaires between the Sámi and Norwegian populations (paper I).
- Aim 2 was to investigate the impact of changes in LTPA on changes in CVD risk factors between 1987-1988 and 2003-2004 in ethnic Sámi and non-Sámi populations (paper II).
- Aim 3 was to examine the association of LTPA, OPA and RHR with all-cause and CVD mortality in ethnic Sámi and non-Sámi populations (paper III).

2 Study population and methods

The thesis is based on data from two population-based studies; the third Finnmark Study in 1987-1988 (Finnmark 3) and SAMINOR 1 in 2003-2004 (Table 1). The Finnmark Study is a repeated population-based health study in the most northern county of Norway, to which total birth cohorts and samples were invited (66, 67). The first study took place in 1974-1975 (Finnmark 1), the second in 1977-1978 (Finnmark 2) and the third in 1987-1988 (Finnmark 3). The National Health Screening Service conducted the study in collaboration with the University of Tromsø and local health authorities. The baseline population of all the papers in the thesis builds on Finnmark 3, as shown in Figure 3.

SAMINOR 1 is a population-based study of health and living conditions in municipalities with both Sámi and Norwegian populations. SAMINOR 1 took place in 2003-2004 and constitutes the follow-up population in paper II. The Centre for Sámi Health Research, Department of Community Medicine, University of Tromsø, conducted the study in collaboration with the National Health Screening Service.

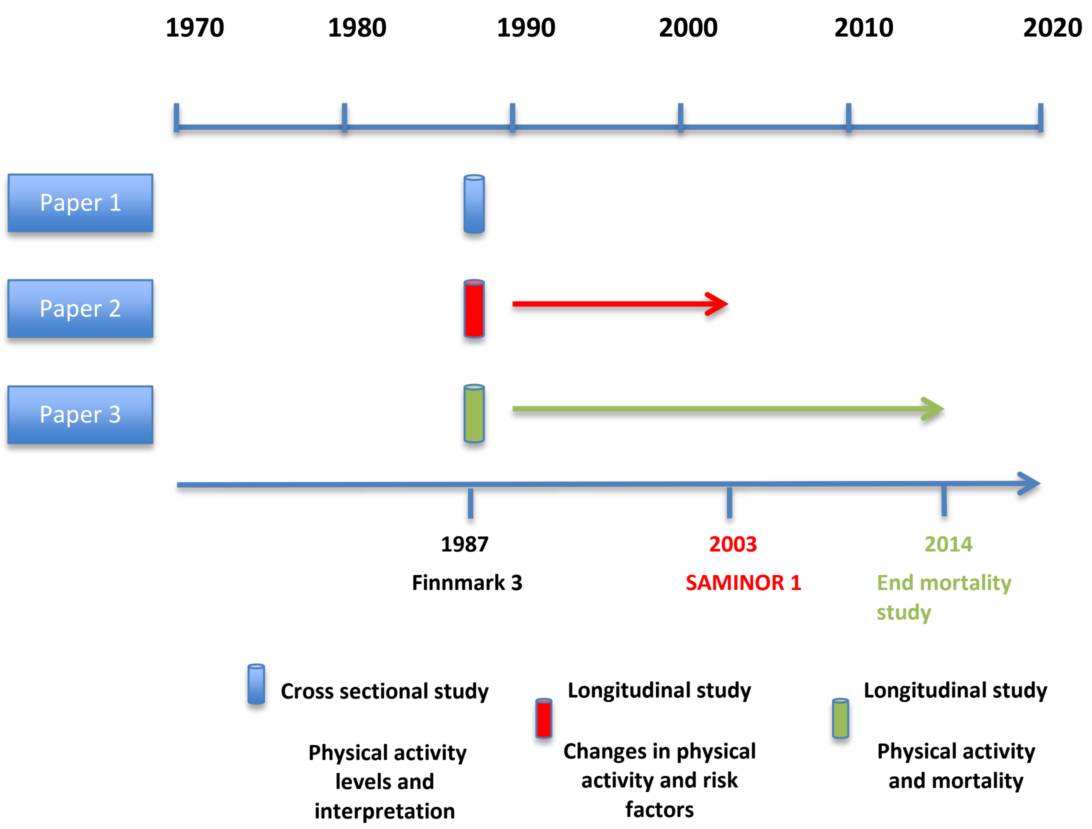


Figure 3. Design of the studies in the thesis

Table 1. Data sources of the papers and cohorts in the thesis

	Study	Number of Sámi and non-Sámi participants (total n)
Paper I	Finnmark 3	1726 Sámi and 8053 Norse (n=9779)
Paper II	Finnmark 3 and SAMINOR 1	1129 Sámi and 2542 non-Sámi (n=3671)
Paper III	Finnmark 3	2813 Sámi and 10777 non-Sámi with known ethnicity (n=17697)

2.1 Paper I

Paper I is a mixed methods study, consisting of both a quantitative and a qualitative cross-sectional design, based on The Finnmark 3 study. In the quantitative part, we examined physical activity levels according to ethnicity based on questionnaires and physical measurements. In the qualitative part, we performed interviews to validate questions used in the study to measure physical activity.

2.1.1 Study population: Finnmark 3

The study in paper I is based on data from the third Finnmark Study in 1987-88 (Finnmark 3). In 1987-88, all resident men and women in Finnmark aged 40-62 years were invited to participate in the screening. In addition, subjects aged 20-39 years, who had been invited to the second survey in 1977 and were still living in Finnmark, together with a 10% random sample of men and women in the same age group, were invited (66). A total of 17864 men and women attended Finnmark 3, representing a 78% attendance rate.

Subjects with missing information about ethnicity (n= 4136) and subjects with missing information about LTPA (n= 11) were excluded. Hence, the study population consisted of 866 men and 860 women of Sámi origin, and 4105 men and 3948 women of Norwegian origin.

2.1.2 Qualitative study of questionnaire interpretation

An interview guide was made in order to explore if Sámi and Norwegian participants perceived and reported the physical activity questionnaire (Table 2) similarly. In 1999, we conducted in depth interviews after purposeful sampling (68, 69) of ten Sámi-speaking persons from the Sámi area in Finnmark, five men and five women, aged 36-73 years with different occupational background. Three were reindeer herdsmen, two were farmers, two were carpenters, one was a nurse, one was a caretaker and the last one was a consultant. Furthermore, interviews were conducted among four

Norwegian farmers and three Norwegian fishermen, aged 27-67 years, among whom one was a woman. The interviews lasted about 30 minutes and the conversations were taped and transcribed with a written consent from the participants. Finally, a professional translator, who had not seen the original Norwegian text, back translated the Sámi version of the questionnaire into Norwegian.

2.1.3 Assessment of physical activity

LTPA and OPA were self-reported and assessed by the "Saltin-Grimby" questionnaire (70, 71), with 4 graded response alternatives, as shown in Table 2. In four municipalities with a high proportion of Sámi inhabitants, the questionnaire was available in both Sámi and Norwegian language. The questionnaire was completed at home, and trained nurses checked the questionnaire for inconsistencies at the screening.

Table 2. Questions regarding physical activity in the Finnmark Study and SAMINOR 1

Study	Questions about LTPA		Answer options
Finnmark 3 SAMINOR 1	State your bodily movement and physical activity in leisure time. If your activity varies much, for example between summer and winter, then give an average. The questions refer only to the last year.	☐	Reading, watching TV or other sedentary activity
		☐	Walking, cycling or other forms of exercise at least 4 hours a week (including walking or cycling to place of work, Sunday walking, etc.
		☐	Participation in recreational sports, heavy gardening, etc. Note: Duration of activity at least 4 hours a week
		☐	Participation in hard training or sports competitions regularly several times a week
Study	**Questions about OPA**		**Answer options**
Finnmark 3	Work related physical activity during the last year.	☐	Sedentary: Mostly sedentary work (e.g. office work, watchmaker, mounting of instruments)
		☐	Moderate: Work with much walking (e.g. shop assistant, light industrial work, education)
		☐	Intermediate: Work with extensive walking and lifting (e.g. postman, heavy industrial work, construction work)
		☐	Intensive: Heavy manual labor (e.g. forestry work, heavy agriculture work, heavy construction work)

2.1.4 Measurement of covariates

Age was obtained from the National Population Registry, and family history of coronary heart disease, CVD and diabetes, level of physical activity at work and during leisure time, smoking habits, and ethnicity were obtained from the questionnaire. RHR and blood pressure were measured by the Dinamap method (72). Three measurements were taken with intervals of one minute, and the lowest value was used in the analysis. Non-fasting blood samples were analyzed for serum total cholesterol and triglycerides at Ullevål hospital, Oslo, Norway.

2.1.5 Ethnicity in Finnmark 3

Ethnicity was self-reported using the following questions (66): "Are two or more of your grandparents of Sámi origin?" and "Are two or more of your grandparents of Finnish origin?" Based on the answers, the participants were classified into five ethnic categories: Finnish (Finnish: yes; Sámi: no or don't know), Sámi (Sámi: yes; Finnish: no or don't know), Norwegian (Finnish: no; Sámi: no), Finnish/Sámi (Finnish: yes; Sámi: yes) and unknown (none of the above).

A total of 12.6% of the participants reported being of Sámi origin, and 59.6% of the men and 57.8% of the women being Norwegians. The remaining was of Finnish, mixed, or unknown ethnicity. Eligible for paper I were participants who reported being of Sámi (17.7%) or Norwegian (82.3%) origin (Table 3).

Table 3. Classification of ethnicity. The Finnmark Study (n= 9779)

	Are two or more of your grandparents of Finnish origin? *Yes*	**Are two or more of your grandparents of Finnish origin? *No***
Are two or more of your grandparents of Sámi origin? *Yes*	*Finnish/Sámi (Finnish: yes; Sámi: yes)* ***(excluded)***	Sámi (Sámi: yes; Finnish: no) **(included)**
Are two or more of your grandparents of Sámi origin? *No*	*Finnish (Finnish: yes; Sámi: no)* ***(excluded)***	Norwegian (Finnish: no; Sámi: no) **(included)**

Sámi: n=1726 (17,7%)
Norwegian (Finnish no; Sámi no): n=8053 (82,3%)

2.1.6 Statistical analyses

SPSS (Statistical Package for Social Sciences, Chicago, IL, USA), version 8.01 was used for all analyses. The figures were made in Fig P, version 2.98. Significant tests were two-sided and the significance level set at 5%. All analyses were stratified by sex and ethnicity. A chi-square test was used to examine possible differences in physical activity by sex and ethnicity, and a two-sample t-test was used to compare group means. We used analysis of covariance (ANCOVA) to examine the association between different levels of OPA and LTPA and age-adjusted levels of RHR and BMI.

2.1.7 Ethics

The Norwegian Data Inspectorate approved the study.

2.2 Paper II

Paper II is a longitudinal cohort study which included subjects from Finnmark 3 in 1987-1988 who also participated in SAMINOR 1 in 2003-2004. Both the Finnmark Study and SAMINOR consisted of questionnaires and physical examinations.

2.2.1 Baseline population: The Finnmark 3 Study

The Finnmark 3 cohort is described in detail above (2.1.1).

2.2.2 Follow-up population: The SAMINOR 1 Study

SAMINOR is a study of health and living conditions in areas in Norway with Sámi and Norwegian settlement. SAMINOR 1 was conducted in 2003-2004 in municipalities in Norway with more than 5 to 10 % of the population reported to be Sámi in the 1970 Census (73). In total, 24 municipalities were included, of which nine were located in the county of Finnmark. All areas had mixed Sámi and non-Sámi populations (74). Details concerning screening procedures and methods have been published previously (74). Briefly, all inhabitants from the preselected municipalities aged 30 and 36-79 years were invited. Subjects who were invited to the cardiovascular screening program in Finnmark in 1987-1988 were also included in the SAMINOR cohort. The questionnaire focused on living conditions, health, Sámi traditions and ethnicity. The self-administrated questionnaire was designed to extract information regarding chronic lifestyle diseases, physical activities, smoking habits and diet, in addition to questions such as age, sex, education and marital status. Information about ethnicity was based on a combination of questions on self-identification and language used at home. The questionnaire and the informed consent forms were available in Sámi and Norwegian languages.

A total of 16489 men and women who were residents of Finnmark were invited to SAMINOR 1, and 10411 subjects (63.1%) participated in the study. Ethnicity was known for 10170 subjects, and 4346 participants reported Sámi affiliation (42.7%) (74).

2.2.3 Selected sample for the analyses in paper II

Paper II included subjects from Finnmark 3 in 1987-1988 who also participated in SAMINOR 1 in 2003-2004. In total, 3671 men and women aged 20-62 years at baseline in 1987-88 were included, of which 1129 were Sámi and 2542 non-Sámi (25).

2.2.4 Cardiovascular risk factors

The following risk factors were included as outcomes: BMI, RHR, triglycerides, cholesterol, DBP and SBP. Height and weight were measured using standard procedures. RHR, SBP, and DBP were measured three times automatically by blood pressure monitor. The mean value of the second and third measurement of blood pressure was used in the analyses, while for RHR, the lowest value of the three measurements was selected. Non-fasting blood samples were collected and analyzed for serum total cholesterol and triglycerides. Blood lipids were measured directly by an enzymatic method (Hitachi auto analyzer, Roche Diagnostic, Switzerland). These laboratory investigations were performed at the Laboratory of the Department of Clinical Chemistry, Oslo University Hospital, Ullevål, Norway.

2.2.5 Leisure time physical activity

In both Finnmark 3 (baseline) and SAMINOR 1 (follow-up), LTPA was assessed by the ”Saltin-Grimby” Physical activity Level Scale (70, 71) and graded 1-4, as shown in table 2. SAMINOR 1 had no questions about physical activity at work; therefore, only LTPA was included in the paper.

To estimate change in LTPA, the original LTPA variable was dichotomized into a sedentary group based on the original sedentary category, with all other categories defined as active. The new constructed variable “Change in physical activity” thus includes the following categories:

(1) Sedentary in both surveys
(2) Reduced activity from active to sedentary
(3) Increased activity from sedentary to active
(4) Active in both surveys.

2.2.6 Ethnicity according to SAMINOR 1

In paper II, ethnicity was defined according to SAMINOR 1 (74). In SAMINOR 1, ethnicity was measured using the following questions:

i) "What language(s) do/did you, your parents and your grandparents use at home?" The questions were to be answered separately for each relative. The available responses were: “Norwegian”, “Sámi”, “Kven” and “Other”. The Kvens are subjects whose ancestry can be traced to the Finnish people who immigrated to Northern Norway in the eighteenth century and earlier. Multiple answers were allowed for each question.

ii) Providing the same response options, we also asked: "What is your, your father’s and your mother’s ethnic background?"

iii) The respondents also reported whether they considered themselves to be Norwegian, Sámi, Kven or other (self-perceived ethnicity).

The Sámi population was defined as those who consider themselves to be Sámi (III) or reported to have a Sámi ethnic background (ii). In addition, at least one grandparent, parents or the participant him/herself should speak Sámi language at home to qualify as a Sámi (i). The remaining participants were categorized as non-Sámi.

2.2.7 Measurement of covariates

Age was obtained from the National Population Registry. Questionnaires were used to assess daily smoking and hypertension, which were self-reported by the questions: “Are you currently a smoker?” (yes/no), and “Do you get treatment for hypertension?” (yes/no).

2.2.8 Statistical analyses

IBM SPSS Statistics, version 23, was used for all analyses. Differences in LTPA in ethnic groups were examined by chi-square test and paired sample t-test to explore whether there were significant changes in unadjusted risk factors from baseline to follow-up. McNemar´s test was used to test the difference in the proportion of sedentary individuals in the two surveys. ANCOVA analysis was used to test the association between change in LTPA and change in CVD risk factors. The analyses were adjusted for age, sex, self-reported daily smoking, ethnicity and baseline values of risk factors. In addition, we adjusted for anti-hypertensive medication at follow-up. Change in risk factors was calculated as the difference in values between baseline and follow-up. Results were presented as mean differences between baseline and follow-up with 95% CI. By adding multiplicative interaction terms to the main multivariable model possible interactions between physical activity and ethnicity, and between physical activity and sex were explored. Model assumptions were assessed by visual inspection of residual plots. Triglyceride values were log transformed because the values did not satisfy model assumptions. P-values were two-sided with a significance level of 0.05.

2.2.9 Ethics

The Norwegian Data Inspectorate approved the Finnmark Study. The SAMINOR 1 study was approved by the Regional Board of Research Ethics in Northern Norway and by the Board's Sámi Consultant. In SAMINOR, all participants gave written informed consent, which included consent to later linkages to national registers, previous censuses, and cardiovascular screenings. The National Data Protection Authority approved the use of personal information and SAMINOR 1 is registered with the number 2002/1525-2. The present study was approved by the Regional Committee for Medical Research Ethics in Northern Norway (REK no. 2013/2249) and the SAMINOR Project Board.

2.3 Paper III

Paper III is a longitudinal, observational population-based study. The Finnmark 3 study cohort was examined in 1987-1988 and followed for CVD and all-cause mortality for 26 years, until the end of 2013.

2.3.1 Baseline population: The Finnmark 3 Study

The Finnmark 3 cohort is described in detail above (2.1.1).

2.3.2 Selected sample for the analyses in paper III

The study III sample included 17697 men and women, aged 20–62 years at examination, with valid data on physical activity and covariates. Of these, 13590 participants reported ethnic affiliation, among which 2813 (20.7%) were categorised as Sámi and 10777 (79.3%) as non-Sámi, constituting a subsample.

2.3.3 Exposure assessment

LTPA at baseline were assessed by the Saltin-Grimby Physical Activity Level Scale (71) with four mutually exclusive options (Table 2). Due to a low number of participants in the highest category of LTPA (n = 224), the two highest physical activity levels, groups 3 and 4 were merged, leaving three groups for the analyses: "Inactive", "Moderate" (walking, bicycling, etc. ≥ 4 h a week) and "Active" (recreational sports etc. ≥ 4 h a week or hard training or competitions several times a week).

OPA levels at baseline were also assessed by the Saltin-Grimby Physical Activity Level Scale (71) with four mutually exclusive options: “Mostly sedentary”, “Walking” (e.g. shop assistant, light industrial work, education), “Walking and lifting” (e.g. mailman, heavy industrial work, construction work) and “Heavy manual labor" (e.g. forestry work, heavy agriculture work, heavy construction work) (Table 2).

RHR was measured during blood pressure monitoring (Dinamap), with the participants sitting down after four minutes rest. Three measurements were taken with an interval of one minute, and the lowest of the three RHR measurements was used in the analyses.

2.3.4 Covariates

Age was obtained from the National Population Registry. Data on daily smoking, previous CVD (myocardial infarction, angina pectoris, and/or stroke), diabetes mellitus, and treatment for hypertension were self-reported (yes/no). Non-fasting blood samples were collected and analysed for serum total cholesterol and triglycerides using an enzymatic method (Hitachi Auto Analyser, Roche Diagnostic, Switzerland). Height and weight of all subjects were measured by the screening nurse and recorded. SBP and DBP levels were measured automatically with the Dinamap blood pressure monitor (72). Three measurements were taken with an interval of one minute, and the mean value of the second and third measurements of blood pressure was used in the present analyses.

2.3.5 Cause of death

Date and underlying cause of death from date of attendance in 1987–1988 through 31 December 2013 were extracted from Norwegian Cause of Death Registry. Death from CVD was defined according to International Classification of Diseases (ICD)-9: 390–459 codes and ICD-10: I00–I99.

2.3.6 Ethnicity

Ethnicity was defined based on the Finnmark 3 cohort by dichotomising four original categories into Sámi (original categories Sámi and Finnish/Sámi) and non-Sámi (original categories Norwegian and Finnish). Classification was based on the two questions: “Are two or more of your grandparents of Sámi origin?” and “Are two or more of your grandparents of Finnish origin?” (66), as shown in Table 4. Those who responded “unknown” were classified as missing.

Table 4. Classification of ethnicity. The Finnmark Study (n=13590)

	Are two or more of your grandparents of Finnish origin? *Yes*	**Are two or more of your grandparents of Finnish origin? *No***
Are two or more of your grandparents of Sámi origin? *Yes*	Sámi (original category Finnish/Sámi)	Sámi (original category Sámi)
Are two or more of your grandparents of Sámi origin? *No*	Non-Sámi (original category Finnish)	Non-Sámi (original category Norwegian)

Sámi: n=2813 (20.7%)
Non-Sámi (Norwegian, Finnish): n=10777 (79.3%)

2.3.7 Statistical analyses

The associations of LTPA, OPA and RHR with CVD and all-cause mortality were estimated by Cox proportional hazard models with days-to-event as the time axis, with hazard ratio (HR) and 95% confidence interval (CI) as effect size. Proportional hazard assumptions were assessed by inspecting the log (-log) survival curves for the various physical activity categories. Model 1 tested the association between either LTPA, OPA or RHR as exposure and all-cause or CVD mortality as outcome, adjusted for age, sex, smoking status and BMI categories. Associations between LTPA and mortality were additionally adjusted for OPA, and vice versa. The model of RHR and mortality did not include OPA or LTPA. In Model 2, we additionally adjusted for self-reported angina pectoris, MI, cerebral insult, diabetes and anti-hypertensive medication, which could represent possible mediators in the association between physical activity and mortality. The analyses were repeated in a subsample (n= 13590) with valid data on ethnicity, stratified by Sámi or non-Sámi. By adding multiplicative interaction terms to the main multivariable models in Cox proportional hazard model, we assessed possible interactions between sex and LTPA, sex and OPA, ethnicity and LTPA, ethnicity and OPA, sex and RHR, ethnicity and RHR, and finally between LTPA and OPA, with OPA treated as a quadratic term. P-values were two-sided with a significance level of 0.05. Data analyses were performed using IBM SPSS Statistics, version 24 (IBM Corporation, Armonk, New York, USA).

2.3.8 Ethics

The Norwegian Data Inspectorate approved the Finnmark Study. The present study and thesis were approved by the Regional Committee for Medical Research Ethics in Northern Norway (REK no. 2013/2249) and from the SAMINOR Project Board. The study was performed in accordance with ethical standards as laid down in the 1964 Declaration of Helsinki and later amendments.

3 Results – summary of papers

3.1 Paper I: Physical activity according to ethnic origin in Finnmark county, Norway. The Finnmark study

The objective of this study was to examine whether there were differences in self-reported physical activity levels between the Norwegian and Sámi populations, and the distribution of RHR and BMI across levels of physical activity. Furthermore, we examined potential differences in the interpretations of the physical activity questionnaires between the Sámi and Norwegian populations.

The design was cross-sectional, based on data from the third Finnmark Study in 1987-1988. The study included 866 men and 860 women of Sámi origin, and 4105 men and 3948 women of Norwegian origin, aged 20-62 years.

Sámi and Norse men differed in LTPA ($\chi^2 = 11.462$, $p=0.009$). The percentage of Sámi men were higher in the sedentary, intermediate and intensive group and lower in the moderate group, whereas Norwegian participants engaged more in moderate LTPA. On the other hand, Sámi women were less active in leisure-time than Norwegian women ($\chi^2 = 21.568$, $p<0.001$). Furthermore, Sámi men and women were more active at work than Norwegian men and women ($\chi^2 = 93.819$, $p<0.001$ for men and $\chi^2 = 59.323$, $p< 0.001$ for women respectively).

We calculated a total physical activity score by combining LTPA and OPA. The lowest possible score was 2 and the maximum obtainable score was 8. A low physical activity score was defined as two to four while high physical activity level was defined as five to eight.

The results showed that the Sámi men and women had a higher total physical activity score and a higher proportion in the high activity group (45.6 % vs. 33.8 %; $\chi^2 = 43.378$, $p<0.001$ for men, and 24.3 % vs. 18.5 %; $\chi^2= 14.993$, $p<0.001$ for women, respectively), mainly driven by higher OPA levels.

Compared to Norwegian men, age-adjusted RHR across levels of OPA were significantly lower among Sámi men and non-significantly lower among Sámi women. Age-adjusted values of RHR and BMI decreased significantly across levels of LTPA in both ethnic groups and sexes.

In-depth interviews addressing how the participants responded to the physical activity questionnaire revealed that Sámi living as reindeer herdsmen and farmers in both ethnic groups did not make a clear distinction between work and leisure time activity. The majority of the day was spent in daily living activities with little time off. Some Sámi reported that fishing, hunting and berry-picking were perceived as neither work or leisure time activity, but something in between as part of their traditions and lifestyle to utilize natural resources. This conception was particularly expressed among Sámi farmers and reindeer herdsmen. This was in contrast to employed Sámi and Norwegian participants with regular working hours who made a clear distinction between work and leisure time.

3.2 Paper II: The impact of changes in leisure time physical activity on changes in cardiovascular risk factors: results from The Finnmark 3 study and SAMINOR 1, 1987-2003

The aim of this study was to explore the association between changes in LTPA and changes in cardiovascular risk factors. Furthermore, we aimed to examine whether these associations differed between Sámi and non-Sámi.

Data were extracted from two population-based studies with a follow-up time of 16 years. This cohort comprised 3671 men and women who participated in both Finnmark 3 and SAMINOR 1. Sámi affiliation was reported by 1129 participants. The remaining participants were defined as non-Sámi.

A higher proportion of the Sámi than the non-Sámi was sedentary in leisure time. We found a lower increase in BMI among those who were active during both surveys compared to those who were persistently sedentary in leisure time. The decrease in triglyceride values was more pronounced in the persistently active group than among the persistently sedentary participants. Otherwise, change in LTPA was not accompanied by changes in cardiovascular risk factors.

There were no ethnic differences in the association between LTPA and cardiovascular risk factors.

3.3 Paper III: Leisure Time and Occupational Physical Activity, Resting heart rate, and Mortality in the Arctic region of Norway. The Finnmark Study

The objective of this study was to examine the association of LTPA, OPA, and RHR with all-cause and CVD mortality in the Finnmark 3 cohort, and to examine whether this association differed in the Sámi and non-Sámi population.

A total of 17697 men and women aged 20-62 at examination were included. Of these, 13590 participants reported ethnic affiliation, among which 2813 were categorized as Sámi and 10777 as non-Sámi, constituting two subsamples.

During 26 years of follow-up, 1983 women and 3147 men died. We found that LTPA was linearly and inversely associated with all-cause mortality. Compared to inactive subjects, all-cause mortality was reduced by 5 % in the moderate LTPA group (HR 0.95; 95% CI 0.89-1.01) and 16% in the active LTPA group (HR 0.84; 95% CI 0.76-0.92).

We found a U-shaped association between OPA and mortality, both from all-cause and CVD. The lowest mortality was observed among subjects reporting walking and lifting OPA, while we observed a 16% higher mortality in the most sedentary OPA group and a 13% higher mortality in the heavy manual labour group.

All-cause mortality increased by 1.1% for each beat per minute increase in RHR (HR 1.011; 95% CI 1.009– 1.013). Similar results were observed for CVD mortality (HR 1.007; 95% CI 1.004–1.011).

All associations were similar in Sámi and non-Sámi subjects.

4 Discussion of methodology

4.1 Internal and external validity

Internal validity can be defined as to which extent we can be confident that the observed association between the exposure and the outcome is true. Alternative explanations for an observed association include chance, bias (systematic errors) and confounders (75, 76). In the different papers of the thesis, we have discussed internal validity related to observed associations, as the alternative explanations (chance, bias or confounders) have to be considered in advance of conclusion of valid association. The internal validity of the studies in this thesis is further discussed in paragraphs 4.2-4.5.

External validity is to what extent the findings in the study is generalizable to other populations (75, 76) and depends on internal validity. Judgement of the generalizability of the findings is often based on discretion and similarity between populations. The mixed ethnic population of Finnmark is living under distinctive climatic conditions in the Arctic of Norway, and there may be factors related to climate or genetics that limit generalizable to many populations.

In this thesis, a main aim was to examine possible differences in the association between physical activity and cardiovascular risk and mortality in Sámi and non-Sámi. Therefore, a discussion of the results in view of ethnicity is emphasized.

4.2 Indigenous methodology

There are some methodological pitfalls to health research in multi-ethnic populations, and topics such as unbiased selection of the participants, equal quality of information across populations and confounding will be discussed in the following paragraphs 4.2-4.5.

Defining an ethnic group is challenging, and self-declaration has emerged as vital in the definition, as described by UN´s Principles and Recommendations for population and Housing Censuses Revision 2 (77) (United Nations 2008: p 139): "*The subjective nature of the term (not to mention increasing intermarriage among various groups in some countries, for example) requires that information on ethnicity be acquired through self-declaration of a respondent and also that respondents have the option of indicating multiple ethnic affiliations*". In the same chapter UN presents a broad definition of ethnicity: "*Ethnicity is based on a shared understanding of history and territorial origins (regional* *and national) of an ethnic group or community, as well as on particular cultural characteristics such as language and/or religion*" (77).

The inclusion criteria of Sámi in studies may influence the results and conclusions (78). In this thesis, ethnicity was self-declared based upon questions concerning the origin of grandparents, classified as Finnish, Sámi, Finnish/Sámi or Norwegian, in the Finnmark 3 study. Information of ethnicity in the Finnmark studies and SAMINOR is based on self-perceived ethnic origin. Different definitions of self-reported ethnicity were used in the Finnmark 3 Study and SAMINOR 1; the latter has somewhat broader definition and is now widely used.

Moreover, in the Finnmark 3 study, around 20% of the participants in the total cohort did not answer the question about ethnic affiliation causing missing data on ethnicity. On the other hand, those who answered the question about ethnicity were very similar to the whole sample in age, gender distribution, CVD risk factors and the prevalence in self-reported CVD. Questions about ethnicity might have been sensitive due to previous discrimination and government policy, and many subjects probably did not actually know their origin and therefore chose not to answer this question, which may have impacted our results.

Finally, participants may identify themselves with more than one group of ethnicity (79). The concept Sámi affiliation is used in official contexts. To participate in elections to Sámi representative body, the Sámi Parliament, you have to fulfil some criteria to join an electoral roll. These criteria have some common features with the definition of Sámi in the SAMINOR studies.

There are some obvious consequences of possible misclassification of Sámi affiliation due to missing date, multi-ethnicity, and different definitions of Sámi in the Finnmark 3 study vs. SAMINOR. The broader definition of Sámi in SAMINOR will affect the numbers that a registered as Sámi and the numerator increases. That means a higher percentage of the participants in the study are defined as Sámi. If the broader definition of Sámi used in SAMINOR 1 means a "dilution" of a traditional life style regarding physical activity we will probably underestimate the real effect of physical activity from a traditional lifestyle among the Sámi. The two groups of Sámi and non-Sámi will probably differ less regarding physical activity. A broader definition could also affect dietary questions. If a broader definition of Sámi includes more participants outside Sámi core area this could affect the levels of CVD risk factors among Sámi and minimize potential differences. Furthermore, there could be potential genetic and biological differences related to the Sámi that also could be diluted with a broad definition of Sámi.

4.3 Selection bias

Selection bias can occur if a sample does not have the same distribution of exposure and outcome as the overall population. The association between exposure and outcome will be biased and not transferable to the population from whom the sample is drawn (75, 80).

In cross-sectional studies, non-responders may bias the study (80). In population-based studies such as the Tromsø Study, non-responders were younger age, male sex, and showed lower socioeconomic status (SES) than responders (81). However, in prospective cohort studies, selection bias is often a minor problem because the outcome of interest is not known at baseline (80).

When comparing ethnic groups in population-based studies, the selection of participants should be unbiased and representative of the populations from which they originate. In epidemiologic survey, participation rates have a tendency to differ by ethnicity (82). In this respect, research on a Sámi population is challenging in the way that we do not know the total number of Sámi and the denominator is uncertain (1). Furthermore, there can be recruiting issues that are related to mistrust to authorities and distrust towards research based on experiences from the past (65, 83).

The Finnmark studies were population bases studies with high attendance rates and approximately 80% in the Finnmark 3 study. Despite this, we cannot exclude that selection bias has occurred, but did probably not influence the observed associations to a great extent.

4.4 Information bias

The information in the included studies was mainly collected through questionnaires. It is likely that some participants unconsciously or deliberately may have given biased answers. This would be a major concern if we had reason to suspect an uneven distribution of information bias in ethnic groups and will be discussed in relation to interpretation of the physical activity questionnaires among Sámi and Norwegian participants (4.4.2). The question about LTPA was based upon recall of the last year and this could obviously influence the answers. This topic is elaborated in the following paragraphs.

4.4.1 Validation of questionnaire used to measure PA

Quantification of physical activity can broadly be divided into objective and self-report methods (84). Objective methods include use of accelerometers that records acceleration, which is translated into movement. These devices are accurate and easy to handle, although more expensive than questionnaires. However, such monitors were not available at the time of physical activity measurement in our studies.

Questionnaires are the most common method for self-reported physical activity (84, 85) and they are based on participant recall. There are numerous physical activity questionnaires that vary by what they measure (e.g., mode, duration, frequency) and how the data are presented (e.g., time, calories, activity scores). Benefits of questionnaires include easy handling, cost effectiveness and possibility for classification of physical activity in discrete categories. There are some obvious disadvantages such as recall bias, less robust in measuring light or moderate physical activity (86), and the tendency to overestimate the activity level, generating misclassification errors (87).

The Saltin-Grimby Physical Activity Level Scale used in Finnmark 3 and SAMINOR 1 seem to have satisfying validity for LTPA (87, 88). The question about LTPA was found to be positively associated with objectively measured physical activity (accelerometer) and physical fitness (maximal oxygen uptake) in a dose-response relationship among men and women (87). However, self-report of physical activity is subject to misclassification errors, as participants tend to overestimate their activity level, which might lead to underestimations of the real effects of physical activity (87). In contrast to LTPA, no association between self-reported OPA and maximal oxygen uptake was observed. The examples of occupations in the questionnaire had broad response categories that could have contributed to a certain degree of information bias. Some respondents might have answered according to their professional identity rather than the actual level of OPA.

4.4.2 Interpretation of physical activity by Sámi and Norwegian participants

In the first paper of this thesis (89), in debt interviews revealed that Sámi reindeer herdsmen and farmers in both ethnic groups did not make a clear distinction between work and leisure time activity, as they had almost no defined leisure time. Most of the time was spent on maintaining livelihood. Traditional activities like fishing, hunting and berry picking were by some of the Sámi classified as something in between work and leisure time activities. Harvesting from nature was a part of their lifestyle.

This lack of distinction between work and leisure could potentially influence the way they responded to questions about physical activity. Since a higher percentage of the Sámi than Norwegians in the 1980´s (20% vs. 8%) (2) were engaged in primary activities (reindeer industry, agriculture and fishing), this could potentially introduce an ethnic response bias.

The questionnaire in this mixed ethnic population did not include traditional Sámi activities that might be physically strenuous such as fishing, hunting and berry picking. An example of less relevant question for the indigenous Sámi population is the question about heavy gardening. The lack of adaptation of questionnaires to a more traditional way of living could contribute to misclassification of physical activity level, especially among the Sámi (89). Participants in both the Finnmark III study and SAMINOR 1 responded to the same questionnaire about LTPA. Although it is obvious that the Sámi society is modernized and becoming more similar to the society at large, there might still be sub-groups of Sámi, in which the questionnaires do not catch the true physical activity levels. However, the numbers of employees in the reindeer industry during follow-up has decreased by 16% from 1990 to 2008 (21). This potential bias will therefore have less significance as times go by. For the majority of participants with permanent employment, questions about physical activity should have similar validity as comparable studies with the same questions about self-reported physical activity (87, 88).

4.4.3 The Norwegian Cause of Death Registry

The Norwegian Cause of Death Registry covers approximately 98% of all deaths in Norway (90). All deaths in Norway are required to be examined by a physician, by examination of the corpse in order to make a declaration of death according to ICD coding system.

There are some challenges associated with the data quality of the Cause of Death Registry (90), including uncertainty about the underlying cause of death, i.e. the disease or injury that initiated the process leading to death. Moreover, autopsy, which is the gold standard to identify the cause of death, is done in roughly 4% of the cases (90, 91). A study by Alfsen and Mæhlen (91) showed that following autopsy, the underlying cause of death was changed in 61% of the cases, and furthermore 32% of the causes were changed to a different ICD code.

On the other hand, Gulsvik et al. (92) examined the diagnostic validity of cerebral stroke and ischemic heart disease as the underlying cause of death when compared to autopsy findings, and found significant accordance between mortality statistics and results from autopsy.

Compared to other Nordic countries The Norwegian Causes of Death Registry has a lower score in quality assessment studies because of frequent use of unspecific codes. Still, internationally, Norway was ranked as having a fairly high quality of the Cause of Death Registry (93, 94).

4.5 Confounding

A confounder is defined by its association with the risk factor and causally association to the outcome, representing an alternative explanation of an observed association between exposure and outcome (75). Confounding may give misleading associations in any direction. Specific measures to control confounding are restriction of selection of the study population, stratification, randomization of exposure, matching of subjects and use of multivariate analyses to adjust for potential confounders (75).

The present work consists of two longitudinal, population-based observational studies. The data were collected many years ago and we have made our best efforts to control confounders by use of multivariate analyses. Based on previous research, we statistically adjusted for factors that potentially could be associated with both exposure and outcome. However, some information was not accessible, including factors such as SES and diet, which could potentially confound our observed associations as discussed in the following.

4.5.1 Socio-economic status

Information about SES may be a potential confounder in population-based health studies, as higher SES is often associated with better health and survival (95-97). One limitation in our studies is the lack of information about SES, which can be a potential confounder when examining the association between physical activity and mortality. Worldwide, low SES is a strong predictor of morbidity and premature mortality and there is also a strong association between low SES and CVD and CVD risk factors (98). Poverty and low SES are modifiable risk factors that need to be have been taken into account in both local and global health strategies (97).

Among indigenous people, the concept of social class may be challenging because of different values, social structures and hierarchy. It is likely that standard questionnaires do not take that into account. Indigenous peoples are often over-represented in lower levels of SES with consequences as loss of statistical power making comparing outcomes across levels of SES complicated (99).

Elements such as exclusion, discrimination and marginalization contribute to uniformity of SES among indigenous populations making improvement of SES challenging (99). Furthermore, it is possible that other social factors than SES affect health among indigenous people. Such elements could be related to the community, culture, family and spirituality (99).

A report from the Norwegian Institute of Public Health (100) based on information from SAMINOR I in 2003-2004 shows major differences in level of education among ethnic groups, especially among the elderly Sámi. Among the oldest Sámi, born before Second World War, approximately 50% did not complete primary school compared to only 10% among Norwegians. Among younger generations, Sámi women had higher level of education than Sámi men.

Unfortunately, in this thesis data concerning SES were not accessible. SES is a potential confounding variable that could contribute to some of the association between physical activity, CVD risk factors and mortality.

4.5.2 Dietary patterns

A study of dietary patterns (22) among Sámi living in traditional reindeer herding areas in the inland of Finnmark in the early 1990´s indicated that Sámi had a higher consume of meat, especially reindeer meat, and fat and less fruits and vegetables, compared to Norwegian in coastal areas. Possible diet differences between Sámi and non-Sámi could potentially be a confounder, but results from the SAMINOR survey indicate that dietary patterns were more related to coastal vs. inland residence than ethnicity (101, 102).

We cannot exclude that there might be other unmeasured confounders and residual confounding, for instance genotype, in our data. Therefore, confounding could potentially be an alternative explanation of the association of physical activity with CVD risk factors and mortality. However, as discussed below, the observed associations in our study are consistent with previous research and biologically plausible.

4.6 Causality

In epidemiology, a cause can be considered to be a factor that alters the frequency of disease, health status, or associated factors in a population (103). Demonstrating causation in epidemiologic studies is challenging; thus, an observed relationship between exposure and disease may reflect associations and not necessarily causal relations (103).

In 1965, Sir Austin Bradford Hill introduced nine criteria for evaluating epidemiologic data for causality (104). These criteria are:

1. Strength of association
2. Consistency
3. Specificity
4. Temporality

5. Biological gradient
6. Plausibility
7. Coherence
8. Experiment
9. Analogy

Statistics cannot prove association or causation (104), but statistical test are useful to express the probability of a relationship between exposure and disease. Evaluating an association according to Hills criteria can never prove causality, but as stated by Bhopal (103) the criteria are helpful to uncover lack of causality thereby implying the need for future research. Evaluating causality in epidemiological studies can also be done by comparing results from other observational, or experimental studies and reviews of non-epidemiological evidence (105).

Although we found support for favourable changes in some CVD risk factors (paper II) with high level of LTPA and an inverse and linear association between LTPA and all-cause mortality (paper III), most associations are not causal (103). Alternative explanations as bias and confounders must be ruled out and discussed (103). The results of the papers will be discussed according to some of Sir Austin Bradford Hills criteria to evaluate potential causality from our observed associations (104). The results are discussed in detail in each paper; therefore, in the following chapter we will discuss the findings in view of Hill´s criteria (104, 106).

5 Discussion of results

5.1 Strength of the association and dose-response relationship

The stronger an association between exposure and outcome, the more likely the relationship is to be causal. A dose-response relationship is thus an indicator of the strength of the observed association and can be applied when making public health recommendations (107).

The effects of physical activity can be evaluated by frequency, intensity, duration and mode of physical activity. The LTPA questionnaire in the Finnmark 3 study is roughly divided into more or less than four hours per week as a volume of activity and crude categories of intensity. The type or frequency of activity is not defined. The dose-response relationship between increasing LTPA and decrease in RHR and BMI (paper I), the modest increase in BMI and decrease in triglyceride values with increasing LTPA level (paper II), and the linear association between LTPA and all-cause mortality (paper III) strengthens the possibility of causality in the studies.

5.2 Consistency with previous research

The term consistency relates to generalizability of findings and to whether these findings are in accordance with comparable studies (103). In agreement with findings from other studies (108), results from our first study (paper I) showed lower RHR with increasing levels of LTPA.

In the study of change in physical activity and change in CVD risk factors (paper II) we found favourable changes in BMI and levels of triglycerides in those who were persistent active during follow-up. This is in accordance with other studies (109-111). The relatively modest changes in risk factors with change in LTPA could indicate that questions about physical activity do not discriminate sufficiently between levels of activity. Furthermore, self-reported physical activity increases the risk of misclassification errors by the tendency of participants to overestimate their activity level (87, 112), thereby masking the true effects of physical activity. Validity studies show that self-reported physical activity is less valid in measuring light activity (86, 87).

Paper III showed that LTPA was inversely associated with all-cause mortality, but not CVD mortality, after adjusting for confounding factors. The latter is in contrast to results from other studies (29, 113). Compared to the rest of Norway, the prevalence of CVD and traditional risk factors for CVD has been higher in Finnmark County. Together with demanding climatic conditions and disturbed circadian rhythm with polar nights during wintertime and midnight sun in the summer, unmeasured confounding variables could potentially mask the association between LTPA and CVD mortality. On the other hand, the lack of association between LTPA and CVD mortality could indicate that LTPA affects all-cause mortality through other pathways than traditional risk factors for CVD. When it comes to the association between LTPA and mortality there is convincing evidence in epidemiologic studies that physical activity is favourable and furthermore improves fitness and physical function. Nevertheless, neither randomised controlled trials or animal studies have been conclusive, leaving the questions about causality still disputed (114).

In paper III we found a 13-16% lower all-cause mortality in the walking and lifting group compared with those in the sedentary and heavy manual labor group of OPA, indicating a U-shaped association between OPA and mortality. The higher mortality among those with high levels of OPA is partly supported by some, but not all previous studies (59).

Interestingly, participants in the active LTPA group did not show this U-shaped association between OPA and mortality. In the active LTPA group, mortality increased linearly increasing with increasing OPA level, suggesting that high LTPA levels may counteract the increased risk of mortality with sedentary OPA.

5.3 Temporality

The cause should precede the effect to substantiate a possible causal association (103). Paper III investigated the association between LTPA and mortality where the measurement of the presumed cause (LTPA) preceded the measurement of the effect (mortality). In paper II, we studied changes in LTPA and CVD risk factors in a longitudinal design, in order to introduce the temporality aspect, and we adjusted for baseline levels of the risk factor of interest to account for reverse causality. The presence of temporality strengthens but does not prove a causal association (103).

5.4 Biological plausibility

In paper II, we found favourable effects of increased physical activity on BMI and triglyceride values and in paper III we found an inverse and linear association between LTPA and all-cause mortality. There are several plausible explanations to positive effects of increased physical activity on CVD risk factors and mortality. Regular physical activity has favourable effect on blood lipids (increases HDL-C), weight gain and metabolic health through improved glucose tolerance and insulin sensitivity (48). Furthermore, physical activity can improve the cardiovascular system by lowering RHR and blood pressure. Exercise increases the production of nitric oxide (NO) in the endothelial cells and causes vasodilation. Moreover, NO inhibits platelet aggregation and leukocyte adhesion to vessel walls (48).

The association between OPA and mortality is less studied than LTPA and the association is inconsistent in cohort studies. Holtermann et al. (61) have proposed a “physical activity paradox”, suggesting that LTPA and OPA have different effects on CVD health and mortality. The “physical activity paradox” suggests that other mechanism than the above mentioned LTPA mechanisms contribute to association of OPA and mortality, including long duration activity, low intensity, static postures, heavy lifting and elevated 24-hour heart rate and blood pressure (61).

6 Conclusions, implications and future research

6.1 Conclusions

The present thesis addressed three specific aims. First, we explored different aspects of physical activity in Sámi and Norwegian ethnic groups in a population-based study in Finnmark county, Norway. Second, we addressed longitudinal changes in CVD risk factors in relation to changes in LTPA in Sámi and non-Sámi populations. Finally, we studied the association of LTPA, OPA and RHR with mortality in these ethnic populations. Results from paper I indicated that Sámi had higher total physical activity score than Norwegians. The study in paper II showed no major changes in CVD risk factors from 1987 to 2004, except for favorable changes in BMI and triglycerides. Paper III showed that LTPA was linearly and inversely associated with all-cause mortality, suggesting that being inactive is an independent risk factor for premature death. The association between OPA and mortality was U-shaped, suggesting different mechanisms for LTPA and OPA. The strength of the relationships was similar in Sámi and non-Sámi subjects, suggesting that measures to increase physical activity levels should be endorsed and implemented with considerations of ethnic and cultural differences in lifestyle and interpretation of the physical activity concept.

6.2 Implications and future research

This thesis presents new knowledge about the association between physical activity, cardiovascular risk factors and mortality among people living under tough climatic conditions in the Arctic. Furthermore, our studies acknowledge the protective effects of physical activity among the indigenous Sámi population as well as among non-Sámi. Considering the lifestyle among ethnic groups and the specific climate, measures to increase physical activity levels are warranted and should be adapted to living conditions more than ethnicity. Moreover, the thesis suggests that physical activity questionnaires should consider ethnic differences in the perception of physical activity as concept accompanied by relevant questionnaire customization.

Norway participates in the global World Health Organization project on reducing the morbidity and premature mortality of non-communicable diseases (CVD, cancer, chronic obstructive lung disease and diabetes) (112). The strategy has a list of indicators to measure changes in risk factors over time, including physical activity. Results from paper I illustrate challenges in adapting physical activity questionnaires that are applicable to different cultural settings. Future research should increase the understanding of the interpretation of physical activity in work and leisure among other indigenous populations. To provide high quality data, future studies of physical activity should include objective measurements of physical activity which may support public health initiatives to promote physical activity (112). Moreover, further studies addressing SES, physical activity, and CVD among indigenous people are warranted.

6.3 Final reflections

When conducting research on the indigenous Sámi people, it is important to be aware of the perspective and point of view of the researcher. Without knowledge of the Sámi history, culture, social structures and way of living, the interpretations of the findings may lack important information, leading to invalid conclusions. As a local Finnmark inhabitant with Norwegian background, the thesis has made it evident that research on the Sámi people need special attention and considerations to ensure that research is carried out in a respectful manner that contributes to knowledge and avoidance of stigmatization.

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Paper 1

PHYSICAL ACTIVITY ACCORDING TO ETHNIC ORIGIN IN FINNMARK COUNTY, NORWAY. THE FINNMARK STUDY

Rune Hermansen, Inger Njølstad, Vinjar Fønnebø

ABSTRACT

Study objective: Is there a difference in self-reported physical activity between the Norse and Sami population, and could the activity levels have been differently reported in the two ethnic groups? ***Design***: Cross-sectional, population-based study. In addition, we performed interviews to validate the questions used in the survey to measure physical activity. ***Setting***: Finnmark County, Norway. ***Participants***: 866 men and 860 women of Sami origin, and 4105 men and 3948 women of Norse origin. Attendance rate 77.7%. In addition, we interviewed ten Sami-speaking and seven Norwegian-speaking persons about physical activity. ***Main results*** : Among men, the two ethnic groups differed in leisure time physical activity (χ''= 11.462, p= 0.009). Sami women were less active than Norse women in leisure time (χ''= 21.568, p< 0.001). Both Sami men and women were significantly more active during work than Norse persons (χ'' = 93.819, p< 0.001 for men and χ'' = 59.323, p< 0.001 for women). ***Conclusions***: Sami men and women were more physically active at work and had a higher total physical activity score than Norse men and women. The variables used to measure different aspect of physical activity seem to be valid in a diverse ethnic population. *(Int J Circumpolar Health 2002; 61: 189-200)*

Keywords: Physical activity, ethnicity

Physical activity seems to act protectively with regard to future risk of cardiovascular disease and death (1-8). It is well established that physical activity improves lipid profile (9-13) and carbohydrate metabolism (13,14), reduces plasma fibrinogen (15-17), lowers blood pressure (8,18-20) and induces weight loss (21). The type and intensity of physical activity needed to ensure health benefits is still unsettled (13,22).

Finnmark is the northernmost county in Norway. The indigenous Sami population constitutes about twenty percent of a total population of approximately 75000 (23). The Samis have a different language and cultural background than the Norse. Agriculture, reindeer herding, fishing, hunting, use of wild berries and other natural resourc-

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es, constitute the fundament of the traditional Sami society. Until the middle of the 20th century, many Sami lived as nomads with their reindeer herd, and their work was hard manual labour (24,25). More recently, the reindeer industry has become motorised. In the 1980's, 30 percent of the Sami population were dependent on the agriculture and reindeer industry, compared to only 6 percent in the general Norwegian society (26). Previous studies from Finnmark County have reported inconsistent findings regarding self-reported physical activity in the different ethnic groups (27,28). It is possible that the questions used may not have detected existing ethnic differences in the actual activity levels. The two ethnic groups might have a different understanding of leisure time and work activity, and the two languages might differ in their ability to describe the same underlying activity level.

The aim of this study was to investigate whether there were differences in self-reported physical activity between Norse and Sami subjects in Finnmark, in a cross-sectional, population-based study. In addition we wanted to explore whether there were any indication that activity levels could have been differently reported by Sami and Norse subjects.

MATERIAL AND METHODS

A population-based survey of cardiovascular risk factors and disease was performed in 1987-1988 in Finnmark County. The National Health Screening Service conducted the survey in collaboration with the University of Tromsø and local health authorities. This was the third survey in the Finnmark Study, which started in 1974. The study design includes repeated population health surveys to which total birth cohorts and samples were invited. The Norwegian Data Inspectorate approved the study.

Invited to the third survey in Finnmark were all resident men and women aged 40-62 years. In addition, all those aged 20-39 years who had been invited to the second survey in 1977 and were still living in Finnmark, together with a 10% random sample of men and women in the same age group were invited. A total of 17864 (77.7%) men and women attended the survey. Further details on study design have been published previously (29-31).

Briefly, all subjects were invited by a personal letter, which included a one-page questionnaire. In four municipalities with a high proportion of Sami inhabitants, the questionnaire was sent in both a Sami and a Norwegian version. Family history of coronary heart disease, prevalent cardiovascular disease and diabetes, level of physical activity at work and during leisure time, ethnicity, and smoking habits were covered. The questionnaire was filled in at home, but trained nurses checked the questionnaire for inconsistencies at the survey and measured the subjects' height and weight. Heart rate and blood pressure was measured by the Dinamap method (32) (an automatic oscillometric method) . Three measurements were taken with intervals of one minute, and the lowest value is used in the analyses. Irregular heart rate or extremely high blood pressure necessitated in a few instances the use of a sphygmomanometer. A non-fasting blood sample was collected and analysed for serum total cholesterol and triglycerides at Ullevål hospital, Oslo.

The questionnaire used these questions to define ethnicity: «Are two or more of your grandparents of Sami origin?» and «Are two or more of your grandparents of Finnish origin?» Based on the answers, "yes", "no" and "don't know", the subjects were grouped into five ethnic categories: Finnish (Finnish: yes; Sami: no or don't know), Sami (Sami: yes; Finnish: no or don't know), Norse (Finnish: no; Sami: no), Finnish/Sami (Finnish: yes; Sami: yes) and unknown (none of above). This classification is identical to the description given in the report from the first cardiovascular study in Finnmark (33).

Among men and women, 12.6% were of Sami origin while 59.6% of the men and 57.8% of the women were of Norse origin. The remaining were of Finnish, mixed, or unknown ethnicity. Eligible for the present study were those defined to be of Sami or Norse origin.

We excluded subjects with missing information about ethnicity (n= 4136) and subjects with missing information about leisure time physical activity (n= 11). Hence, the study population consisted of 866 men and 860 women of Sami origin, and 4105 men and 3948 women of Norse origin. More than 50% of the Samis lived in the traditional Sami municipalities, where the reindeer industry dominant.

Assessment of physical activity

Respondents were asked to consider four response alternatives and tick the one that fitted best. If two or more alternatives were ticked, a trained nurse corrected the questionnaire at the place of examination after further information from the person. The alternative indicating the highest degree of physical activity was chosen. Information on physical activity during leisure time and work referred to the last year.

Physical activity level during leisure time was graded 1 to 4:

1. Sedentary: Reading, watching TV, or other sedentary activities.
2. Moderate: Walking, bicycling, or moving around in other ways at least 4 hours a week (including walking or cycling to place of work, walks on Sundays etc.).
3. Intermediate: Participating in recreational sports, heavy garden work etc. (note: duration of activity at least 4 hours a week).
4. Intensive: Participating in hard training or athletic competitions regularly and several times a week.

Physical activity level at work was graded 1 to 4:

1. Sedentary: Mostly sedentary work (e.g. office work, watchmaker, mounting of instruments).
2. Moderate: Work with much walking (e.g. shop assistant, light industrial work, education)
3. Intermediate: Work with extensive walking and lifting (e.g. postman, heavy industrial work, construction)
4. Intensive: Heavy manual labour (e.g. forestry work, heavy construction work).

Definition of total physical activity score:
We constructed a new variable that was the sum of physical activity during leisure time and work. The minimum possible score was 2 and the maximum obtainable score was 8. A low physical activity score was defined as two to four while five to eight defined a high physical activity level.

Qualitative study of questionnaire interpretation

We performed in depth interviews in order to investigate whether self-reported physical activity could have been differently reported by Norse and Sami respondents. An interview guide was made, based upon questions about physical activity at work and in leisure time. We made a purposeful sampling (34,35) of ten Sami-speaking persons who could converse in Norwegian, five men and five women, aged 36 - 73 years living in the predominantly Sami area in Finnmark. The Samis had the following background: Three of them were engaged in reindeer herding, two were farmers, two were carpenters, one was a nurse, one was a caretaker and one was a consultant. In addition we interviewed three Norse fishermen and four Norse farmers, aged 27 –67 years, of whom one was a woman. The interviews were performed in 1999 by the first author and averaged approximately thirty minutes. With the written consent from the respondents, all conversations were taped and transcribed.

In addition we had the Sami version of the questionnaire backtranslated into Norwegian by a professional translator, who had not seen the original Norwegian version.

Data analysis

We examined levels of physical activity among men and women by ethnic group, using the chi-square test. All analyses were sex-specific. In women, we combined leisure time physical activity group three (intermediate) and four (intensive) because there were only four Sami and 20 Norse subjects in the most intensive group. Two-sample t-tests were used to compare means. Analysis of covariance was used to examine the associations between different levels of physical activity in leisure and work and exposure variables. The body mass index (BMI) was computed as the weight in kilograms divided by the square of the height in meters. Numbers of subjects in the tables vary slightly because of missing values. All significance tests were two-tailed and the significance level was chosen at 5%. The SPSS statistical package version 8.01 was used. The figures were made in Fig P, version 2.98.

RESULTS

As shown in Table 1, the proportion of smokers and mean values of BMI, systolic blood pressure and triglycerides were similar in Norse and Sami men, but serum cholesterol was 0.16 mmol/l higher among the Samis (95% confidence interval (CI) of difference= 0.06 - 0.25). Sami men had 1.7 beats/minute lower heart rate (CI of difference=

Table I. Characteristics of study population. The Finnmark Study 1987.

	Men				Women			
	Norse (n=4105)		Sami (n=866)		Norse (n=3948)		Sami (n=860)	
Varibles	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age (y)	47.2	9.1	47.2	9.1	46.8	9.6	46.7	9.5
BMI (kg/mΔ)	25.8	3.3	25.9	3.2	25.2	4.3	26.7	4.8
Heart rate (beats/min)	73.0	13.4	71.3	13.1	76.5	12.8	75.4	12.4
Diastolic blood pressure (mmHg)	81.1	10.8	80.2	11.5	77.2	10.7	78.0	11.7
Systolic blood pressure (mmHg)	134.1	16.5	135.0	17.2	128.1	18.6	131.3	21.1
Cholesterol (mmol/l)	6.47	1.26	6.63	1.32	6.46	1.40	6.66	1.42
Triglycerides (mmol/l)	2.08	1.48	2.09	1.41	1.54	0.96	1.71	1.15
Daily smokers (%)	51.9		50.1		45.9		38.4	
Antihypertensive treatment (%)	6.7		5.5		7.9		7.8	

0.7 – 2.7), compared to Norse men. Fewer Sami than Norse women were daily smokers (χ'' = 16.078, p < 0.001) (Table I). BMI, systolic blood pressure and serum lipids were higher, but heart rate was 1.1 beats/minute lower (CI of difference= 0.1 – 2.0) in Sami women as compared to Norse women.

Norse and Sami men differed in leisure time physical activity (χ''= 11.462, p= 0.009) (Table II). The percentage of Sami men was lower in the moderate group, but higher in the sedentary, intermediate, and intensive groups. Sami women were less active in leisure time than Norse women (χ''= 21.568, p< 0.001).

Sami men and women were more active at work than Norse men and women (χ'' = 93.819, p< 0.001 for men

Table II. Physical activity during leisure-time by ethnic groups and sex. The Finnmark Study 1987.

			Activity level				
Sex	Ethnicity	Total n	Sedentary n (%)	Moderate n (%)	Intermediate n (%)	Intensive n (%)	P-value
Men	Norse	4105	1037 (25.3)	2216 (54.0)	771 (18.8)	81 (2.0)	
	Sami	866	240 (27.7)	418 (48.3)	182 (21.0)	26 (3.0)	0.009
			Sedentary n (%)	Moderate n (%)	Active n (%)		
Women	Norse	3948	975 (24.7)	2676 (67.8)	297 (7.5)		
	Sami	860	269 (31.3)	512 (59.5)	79 (9.2)		0.000

Active = intermediate and intensive group

Table III. Physical activity at work by ethnic groups and sex. The Finnmark Study 1987.

			Activity level				
Sex	Ethnicity	Total n	Sedentary n (%)	Moderate n (%)	Intermediate n (%)	Intensive n (%)	P-value
Men	Norse	4103	1640 (40.0)	1144 (27.9)	878 (21.4)	441 (10.7)	
	Sami	864	265 (30.7)	210 (24.3)	197 (22.8)	192 (22.2)	0.000
Women	Norse	3947	1263 (32.0)	1952 (49.5)	679 (17.2)	53 (1.3)	
	Sami	859	208 (24.2)	432 (50.3)	179 (20.8)	40 (4.7)	0.000

and χ″ = 59.323, p< 0.001 for women respectively) (Table III).

When we combined physical activity in leisure and work into a total physical activity score, Sami men and women had a higher proportion in the high activity group than the Norse (45.6 % vs 33.8 %; χ″= 43.378, p< 0.001 for men, and 24.3 % vs 18.5 %; χ″= 14.993, p< 0.001 for women, respectively) (not shown). The main contributor to the difference in total physical activity between Norse and Sami came from physical activity at work.

In both sexes and ethnic groups, age-adjusted values of heart rate and BMI decreased significantly across levels of leisure-time physical activity (Fig. 1 and 2).

Heart rate in Norse men was 75.5 beats/minute in the sedentary group and 59.8 beats/minute in the intensive group, and 72.8 beats/minute and 59.4 beats/minute, respectively, in Sami men (Fig 1). In women, heart rate differed from 78.2 beats/minute to 73.5 beats/minute and from 76.5 beats/minute to 71.8 beats/minute in Norse

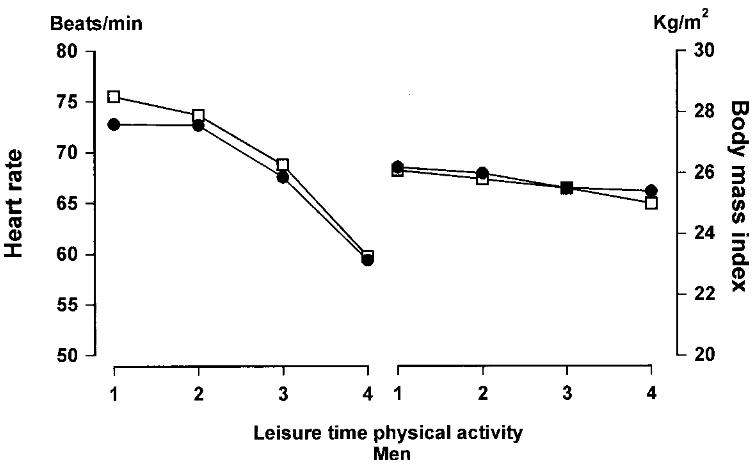

Fig. 1. Age-adjusted values of heart rate and body mass index levels across levels of leisure time physical activity in men. Black circles represent Sami men and open squares represent Norse men.

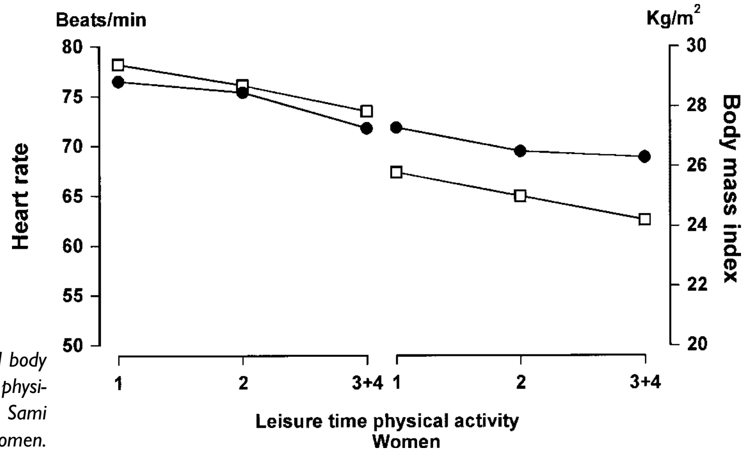

Fig. 2. Age-adjusted values of heart rate and body mass index levels across levels of leisure time physical activity in women. Black circles represent Sami women and open squares represent Norse women.

and Sami women, respectively (Fig 2). In men, BMI was 26.1 kg/m″ in the sedentary group and 25.0 kg/m″ in the intensive group among the Norse and 26.2 kg/m″ and 25.4 kg/m″, respectively, among the Samis (Fig 1). BMI in women differed from 25.8 kg/m″ in the sedentary group to 24.2 kg/m″ in the active group among the Norse and likewise among the Sami from 27.3 kg/m″ to 26.3 kg/m″ (Fig 2).

Sami men had a significantly lower heart rate across levels of physical activity at work, compared to Norse men ($p < 0.001$) (Fig 3). In the intensive group, Sami men

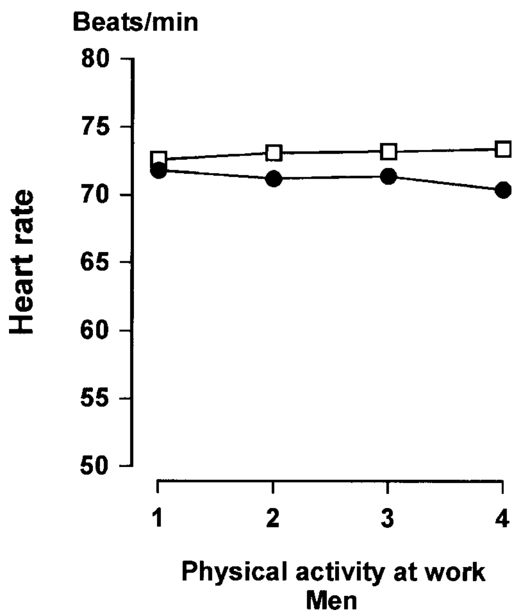

Fig. 3. Age-adjusted values of heart rate across levels of physical activity at work in men. Black circles represents Sami men and open squares represent Norse men.

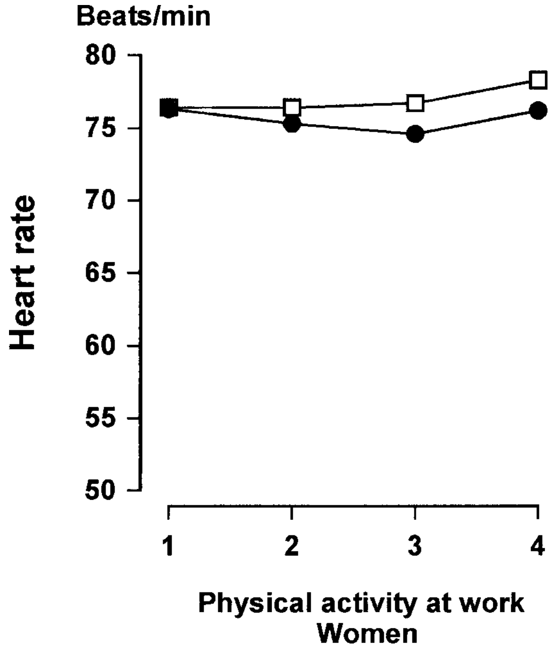

Fig. 4. Age-adjusted values of heart rate across levels of physical activity at work in women. Black circles represents Sami women and open squares represents Norse women.

had a lower heart rate of 3.0 beats/minute. Sami women had a nonsignificantly lower heart rate of 2.1 beats/minute (p= 0.082) in the intensive group (Fig 4).

Interpretation of physical activity by Sami and Norse subjects

Employed Sami and Norse subjects with defined working hours made a strict distinction between work and leisure time. Local Norse fishermen did the same, but they defined their leisure time to be only in the weekend. They worked hard during the week and claimed to have almost no spare time. Samis living as reindeer herdsmen, and farmers in both ethnic groups did not make a clear distinction between work and leisure time activity. Most of their time was utilised in activities for daily living and they had almost no defined leisure time. Some of the Samis said that fishing, hunting and berry-picking were neither defined as work nor leisure time activities, but something in between. It was part of their lifestyle to harvest from nature. This point of view seemed to be present in only Sami farmers and reindeer herdsmen. Years ago, some of them sold berries as a contribution to their family income. In that context berry-picking was defined as work. Samis with regular working hours defined fishing, hunting and berry picking as leisure-time activity. The Norse, independent of occupation, did the same, but some of the Norse interviewees said that berry-picking formerly was a part of the family income.

The back-translation from Sami to Norwegian did not differ substantially from the original questionnaire.

DISCUSSION

In this population-based study from Finnmark County, Norway, we found that Sami men and women were more physically active than the Norse population. The ethnic difference in activity was mainly due to a higher activity level at work in the Sami population. The qualitative part of this study raised the possibility that there may even have been an underreporting of leisure-time physical activity, especially among Samis with occupations related to agriculture and reindeer herding.

We do not know the attendance rate in each ethnic group, since ethnicity was self reported at the screening. However, the overall attendance rate in the study population was high, and similar in the Sami municipalities and other municipalities.

There are other potential sources of bias in this study that need to be considered. First, questions about physical activity were based upon recall over the last 12 months. In an evaluation of physical activity assessment methods (36), the same questions as those used in the present survey, scored 8 on a scale from 0-14. (The maximum score given was 10). We have no reason to believe that recall of physical activity was expressed differently in the two ethnic groups. Second, different interpretations of questionnaire linguistics have been offered as one explanation for geographical differences in self-reported health in Norway (37). The questionnaire in this study had been translated from Norwegian into Sami. The reverse translation of the questions on physical activity showed a strong consistency with the original questionnaire. However, questions about physical activity in this survey provided broad response categories with distinct cues about desired information. Traditional Sami activities, which can be physically strenuous, were neither specified in the question on leisure-time activity nor in the question on work-related activity. In contrast, those activities specified, such as heavy gardening

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and forestry work, may be less relevant for indigenous inhabitants in the Arctic region.

The interviews, on the other hand, indicated that farmers in both ethnic groups and Sami reindeer herdsmen did not make a strict distinction between work and leisure time. In the interviews, Sami farmers and reindeer herdsmen classified fishing, hunting and berry picking as self-support and something in between work and leisure time. It is possible that a lack of distinction between work and leisure time could have influenced the way they answered questions about physical activity. Furthermore, since the proportion of inhabitants engaged in the agriculture and reindeer industry is higher among the Samis than the Norse (26), this may have introduced an ethnic response bias to the self-reported physical activity levels according to the questionnaire. However, the questionnaire survey and the interviews were performed 11 years apart, and it is impossible to assess directly whether and to what extent such a bias actually did occur. On the other hand, heart rate and BMI were lower in the two ethnic groups and in both sexes with higher leisure time physical activity, and the relation between heart rate and BMI and leisure-time physical activity did not differ between the ethnic groups. The variable "Physical activity during leisure-time" thus seems to be a useful assessment tool also in this population with possible ethnic-related diverging understanding of the survey questions. This is in accordance with findings in other study populations (9,10,19).

A high level of work-related physical activity is often a marker of unskilled manual labour and is commonly used as an indicator of low social class (38), while endurance exercise training is known to decrease heart rate at rest and to increase heart rate variability (39,40). The proportion of subjects in our study who classified themselves as having intermediate and intensive physical activity at work, was higher among the Samis than in the Norse group. Compared to industrial workers, the work of Sami farmers and reindeer herdsmen probably involves a higher proportion of aerobic activity and less static work. Thus, it is possible that Samis achieve health benefits through work-related physical activities. To explore this hypothesis, we studied the association between physical activity levels at work and heart rate, using heart rate as an indirect measure of fitness. Overall, Samis of both genders had lower heart rate compared to Norse, although significantly only

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in men. The ethnic difference was higher in the intensive group. The lower heart rate among Sami men and women could be a result of a higher aerobic activity at work and better fitness, compared to the Norse. This remains, however, a speculation.

BMI was similar in Sami and Norse men and significantly higher in Sami women as compared to Norse women in our study. In a study from Finnmark in 1999 (41), the dietary pattern and nutrient intake among Samis were investigated and compared with a group of Norse. The Samis consumed more meat, fat, table sugar and coffee and less fruits and vegetables. The mean energy intake was significantly higher among Sami (12646 KJ) than Norse (10501 KJ) men, but BMI was similar. The authors concluded that it is likely that Sami men have a lifestyle with a higher degree of physical activity and energy expenditure than men of Norse origin. Our findings of higher total physical activity score, especially among men of Sami origin, but similar BMI in Norse and Sami men, are consistent with that theory.

In summary, we found that Sami men and women were more physically active at work and therefore had a higher total physical activity score than Norse men and women. Even if the qualitative part of our study illustrated difficulties in generating questions in one cultural context and applying it in another cultural setting, the physical activity variables seemed to be valid in a diverse ethnic population.

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The impact of changes in leisure time physical activity on changes in cardiovascular risk factors: results from The Finnmark 3 Study and SAMINOR 1, 1987–2003

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ABSTRACT

Objective: The aim of this study was to examine the associations between changes in leisure time physical activity and changes in cardiovascular risk factors over 16 years and whether they differ between two ethnic groups in Norway.

Methods: Data were extracted from two population-based studies. Altogether, 3671 men and women participated in both surveys, and 30% reported being of Sami ethnicity. Leisure time physical activity was self-reported, and cardiovascular risk factors were measured. ANCOVA analysis was used to examine associations between changes in physical activity and changes in cardiovascular risk factors.

Results: After adjustment for age, sex, smoking, ethnicity and respective baseline values, favourable changes in body mass index (BMI) and levels of triglycerides were most pronounced in those who were active in both surveys ($p < 0.05$) whereas the opposite was the situation for cholesterol levels ($p = 0.003$). Changes in systolic blood pressure, diastolic blood pressure and resting heart rate were not significantly associated with change in physical activity. Ethnicity did not influence the associations between physical activity and cardiovascular risk factors.

Conclusion: Traditional cardiovascular risk factors were to a small extent associated with change in leisure time physical activity. Persistent physical activity was associated with beneficial changes in BMI and triglycerides.

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Physical activity; ethnicity; cardiovascular risk factors; longitudinal; Sami

Introduction

A sedentary lifestyle is considered a health risk, and physical activity is an important modifiable factor contributing to risk reduction of cardiovascular diseases (CVD) and death [1–3]. Although the incidence of CVD in Norway has declined over the last decades [4], CVD is still a major cause of premature death and morbidity, and focus on preventive measures such as physical activity should continue [5–7].

Although numerous intervention studies suggest beneficial effects of physical activity on cardiovascular risk [8], the majority of studies are restricted to a single point measure of physical activity. The relatively few studies that have included repeated measurements of leisure time physical activity indicate that increased physical activity is associated with improved glucose, insulin and lipid metabolism and may prevent or delay the onset of metabolic syndrome [9,10]. Due to the scarcity of studies concerning change in physical activity and CVD risk factors, and because many individuals change their behaviour over time [11], we wanted to address this issue in a cohort of Norwegian adults of different ethnic origin with repeated measurements of physical activity.

The main aim of this study was to examine the association between changes in leisure time physical activity and changes in cardiovascular risk factors. Additionally, we aimed to examine whether the relationship between change in leisure time physical activity and change in cardiovascular risk factors differs between two ethnic groups in Norway.

Methods

Study population

Baseline population: the Finnmark 3 Study

The Finnmark Study is a population-based study of cardiovascular risk factors and disease in Finnmark

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County. The study started in 1974 and was conducted by the National Health Screening Service in collaboration with the University of Tromsø and local health authorities. The study design included repeated population health surveys, to which total birth cohorts and samples were invited. The present analyses are based on data from the third Finnmark Study in 1987–1988. The study was approved by The Norwegian Data Inspectorate.

All resident men and women aged 40–62 years were invited to Finnmark 3. In addition, subjects aged 20–39 years, who had been invited to the second survey in 1977 and were still living in Finnmark, together with a 10% random sample of men and women in the same age group, were also invited. A total of 17,864 men and women attended Finnmark 3, representing 78% attendance rate. Briefly, all subjects were invited by a personal letter to Finnmark 3, which included a one-page questionnaire. In four municipalities with a high proportion of Sami inhabitants, the questionnaire was available in both Sami and Norwegian language. Family history of coronary heart disease, prevalent CVD and diabetes, level of physical activity at work and during leisure time, ethnicity, and smoking habits were covered. The questionnaire was completed at home and checked by trained nurses for inconsistencies at the clinical examination. Further details on the study design have been published previously [12,13].

Follow-up population: the SAMINOR 1 Study

SAMINOR is a study of health and living conditions in areas in Norway with Sami and Norwegian settlement. The indigenous Sami population is a minority living in the northern part of Norway, Finland, Sweden and Russia's Kola Peninsula. Traditionally, a relatively high proportion of the Samis have been working with agriculture and reindeer herding. SAMINOR 1 was conducted in 2003–2004 in municipalities in Norway with more than 5–10% of the population reported to be Sami in the 1970 Census [14]. In total, 24 municipalities were included, of which nine were located in the county of Finnmark. All areas had mixed Sami and non-Sami populations [15]. The SAMINOR 1 Study included questionnaires and a basic clinical examination. Details concerning screening procedures and methods have been published previously [15]. Briefly, all inhabitants from the preselected municipalities aged 30 and 36–79 years were invited. Subjects who were invited to the cardiovascular screening program in Finnmark in 1987–1988 were also included in the SAMINOR cohort. The questionnaire focused on living conditions, health, Sami traditions and ethnicity. The self-administrated questionnaire was designed to extract information regarding chronic lifestyle diseases, physical activities, smoking habits and diet, in addition to questions such as age, sex, education and marital status. Information about ethnicity was based on a combination of questions on self-identification and language used at home. The questionnaire and the informed consent forms were available in Sami and Norwegian languages. The SAMINOR 1 Study was accredited by the Regional Board of Research Ethics in Northern Norway and by the Board's Sami Consultant. The survey is in accordance with the Helsinki Declaration of 1975. The National Data Protection Authority approved the use of personal information, and the study is registered with the number 2002/1525–2. A total of 16,489 men and women who were residents of Finnmark were invited to SAMINOR 1, and 10,411 subjects (63.1%) participated in the study. Ethnicity was known for 10,170 subjects, and 4346 participants reported Sami affiliation (42.7%) [15].

Selected sample for the present analyses

The cohort included in the present analyses consisted of participants from the 1987–1988 survey (Finnmark 3) who also participated in SAMINOR 1 in 2003–2004. The total number of subjects included was 3671 men and women aged 20–62 years at baseline, of which 1129 were Sami and 2542 non-Sami.

Questionnaire, blood sample and other measurements

Cardiovascular risk factors

We included the following risk factors as outcomes: body mass index (BMI), resting heart rate (RHR), triglycerides, cholesterol, diastolic blood pressure (DBP) and systolic blood pressure (SBP). Change in risk factors is expressed as the difference in values between baseline and follow-up. Non-fasting blood samples were collected and analysed for serum total cholesterol and triglycerides. At both surveys, blood lipids were measured directly by an enzymatic method (Hitachi auto analyser, Roche Diagnostic, Switzerland). These laboratory investigations were performed at the Laboratory of the Department of Clinical Chemistry, University Hospital in Ullevål, Oslo, Norway.

The height and weight of all subjects were recorded. In both studies, RHR, SBP and DBP were measured automatically by the Dinamap (Criticon) blood pressure monitor [16]. Three measurements were taken with an interval of 1 min, and the mean value of the second and third measurements of blood pressure is used in the present analyses. The lowest of the three heart rate measurements was chosen as the RHR value.

Leisure time physical activity

In both surveys, leisure time physical activity was assessed by the 'Saltin-Grimby' questionnaire at baseline and follow-up [17] and graded 1–4 as follows:

(1) Sedentary: Reading, watching TV or other sedentary activities.
(2) Moderate: Walking, bicycling, or moving around in other ways at least 4 h a week (including walking or cycling to place of work, walks on Sundays, etc.).
(3) Intermediate: Participating in recreational sports, heavy garden work, etc. (note: duration of activity at least 4 h a week).
(4) Intensive: Participating in hard training or athletic competitions regularly and several times a week.

To define change in leisure time physical activity, the original variable leisure time physical activity was dichotomized into a *Sedentary* group representing the original sedentary category, with all other categories defined as *Active*. Based on this dichotomized variable, we constructed a new variable labelled 'Change in physical activity' with the following categories:

(1) Sedentary in both surveys,
(2) Reduced activity from active to sedentary,
(3) Increased activity from sedentary to active and
(4) Active in both surveys.

Covariates

Age was obtained from the National Population Registry. Daily smoking was self-reported by the question: 'Are you currently a smoker' (yes/no)? In SAMINOR 1, ethnicity was measured using the following questions: *What language(s) do/did you, your parents and your grandparents use at home?* The questions were to be answered separately for each relative. The available responses were 'Norwegian', 'Sami', 'Kven' and 'Other'. The Kvens are subjects whose ancestry can be traced to the Finnish people who immigrated to Northern Norway in the eighteenth century. Multiple answers were allowed for each question. Providing the same response options, we also asked: *What is your, your father's and your mother's ethnic background?* The respondents also reported whether they considered themselves to be Norwegian, Sami, Kven or other (self-perceived ethnicity) [15]. In the present study, the Sami population were those who consider themselves to be Sami or reported to have a Sami ethnic background. In addition, at least one grandparent, parents or the participant him/herself should speak Sami language at home to qualify as a Sami. The remaining participants were categorized as non-Sami.

Statistical analysis

Data analyses were performed using IBM SPSS Statistics, version 23 (IBM Corporation, Armonk, NY, USA). A chi-square test for association was conducted to estimate differences in leisure time physical activity between Sami and non-Sami, and paired-samples *t*-test was used to determine whether there were statistically significant changes in unadjusted risk factors from baseline to follow-up (Figure 1). McNemar´s test was applied to test the difference in the proportion of sedentary individuals in the two surveys. ANCOVA analysis was used to test the association between change in leisure time physical activity and change in cardiovascular risk factors. To test any statistical difference between physical activity groups, we used the contrast function in ANCOVA. ANCOVA analyses were adjusted for age, sex, self-reported daily smoking, ethnicity and baseline values. Results were presented as mean differences between baseline and follow-up values with 95% confidence intervals. Possible interactions between physical activity and ethnicity, and between physical activity and sex were assessed by adding multiplicative interaction terms to the main multivariable models. Model assumptions were assessed by visual inspection of residual plots. Triglyceride values did not satisfy model assumptions and were log transformed. *P* values were two-sided with a significance level of 0.05.

Results

Characteristics of participants at baseline and follow-up by leisure time physical activity level are shown in Tables 1–2. The study included 1886 female and 1785 male participants. Mean baseline age was 45.2 (SD 8.6) years. Sami affiliation was reported by 1129 participants (30.8%). There was a reduction in BMI, DBP, RHR, triglycerides and smoking prevalence across subgroups of leisure time physical activity at baseline (Table 1), which was observed in both ethnic groups (Table 1). At follow-up, BMI, triglycerides, the prevalence of smoking and treatment for hypertension decreased with increasing levels of leisure time physical activity (Table 2). Overall, the proportion of sedentary individuals decreased from 27.8% at baseline to 24.6% at follow-up ($p < 0.05$). In both

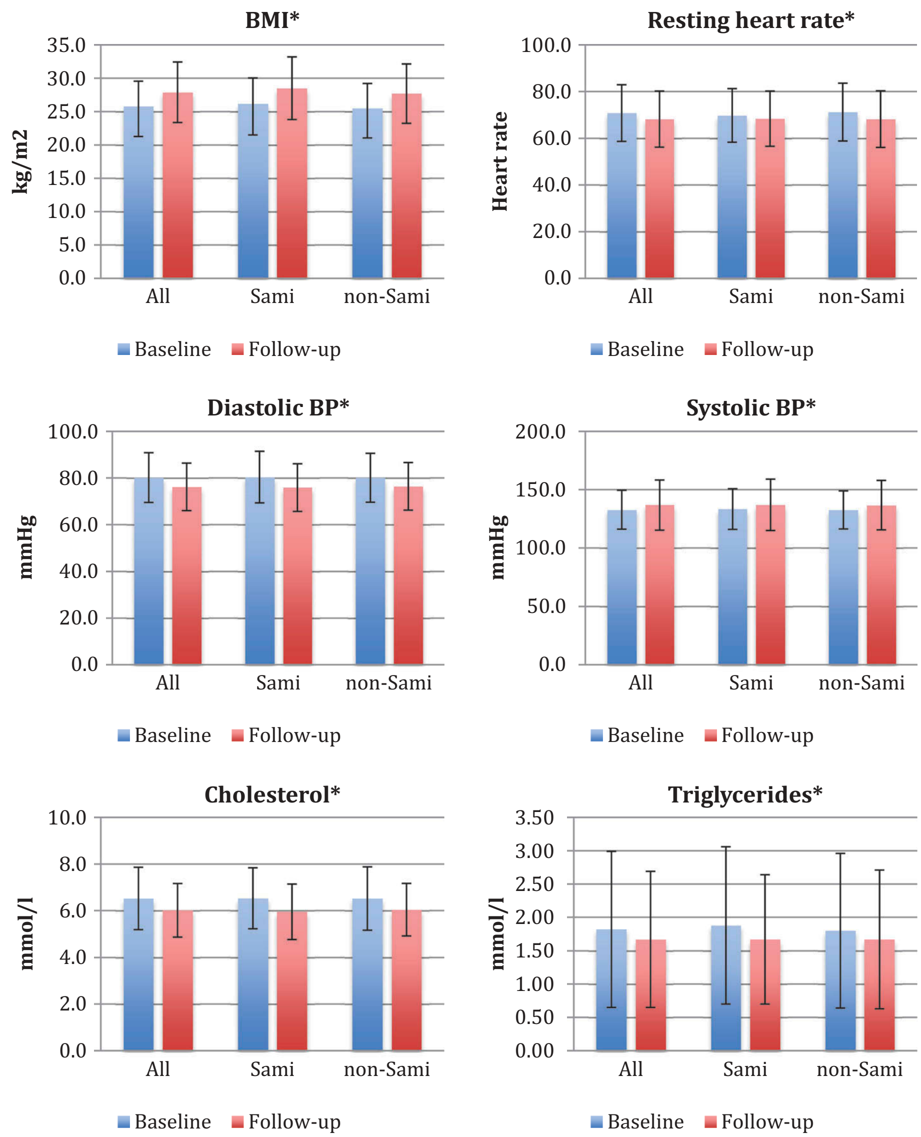

Figure 1. Changes in cardiovascular risk factors (body mass index, resting heart rate, diastolic blood pressure, systolic blood pressure, cholesterol, triglycerides) from 1987/1988 to 2003/2004.

[a] All differences between baseline and follow-up were significant at $p < 0.001$ for all risk factors. Error bars indicate SD.

surveys, a higher proportion of the Samis compared to the non-Samis were sedentary ($p < 0.05$; Table 1–2).

All cardiovascular risk factors in the total cohort changed over time, with an increase in BMI with 2.2 kg/m^2 and SBP with 4.0 mmHg, and a decrease in RHR with 2.5 beats/min, DBP with 4.0 mmHg, cholesterol with 0.51 mmol/l and triglyceride levels with 0.15 mmol/l ($p < 0.001$; Figure 1). These relationships were consistent irrespective of ethnicity.

After adjustments for age, sex, smoking habits, ethnicity and respective baseline values, there were statistically significant differences between persistent physical activity vs persistent sedentary for BMI ($p = 0.035$) and cholesterol ($p = 0.003$) and between persistent active and active to sedentary group for triglycerides ($p = 0.005$) (Table 3). Those who were active during both surveys had a 0.3 kg/m^2 lower increase in BMI compared to those who were sedentary in both surveys ($p = 0.025$). On the other hand, those who were persistently active had the lowest reduction in cholesterol compared to the persistently sedentary group ($p = 0.003$). RHR, diastolic and systolic blood pressure did not change significantly with change in physical activity. Further adjustment for anti-hypertensive medication at follow-up did not change the results significantly for diastolic and systolic blood pressure.

Table 1. Characteristics of participants at baseline (Finnmark 3, 1987–1988) by leisure time physical activity level.

		Sami (n = 1129)				Non-Sami (n = 2542)			
	Total (n = 3671)	Sedentary	Moderate activity	Intermediate activity	Intensive activity	Sedentary	Moderate activity	Intermediate activity	Intensive activity
N (%)		356 (31.5)	569 (50.4)	182 (16.1)	22 (1.9)	664 (26.1)	1475 (58.0)	371 (14.6)	32 (1.3)
Men (%)	1785 (48.6)	155 (28.9)	229 (42.6)	136 (25.3)	17 (3.2)	327 (26.2)	634 (50.8)	261 (20.9)	26 (2.1)
Age (years)	Mean 45.2 (SD 8.6)	43.6 (8.7)	46.7 (8.6)	44.6 (9.1)	36.4 (9.5)	44.0 (8.3)	46.0 (8.6)	44.7 (8.1)	38.7 (7.6)
Body height (cm)	Mean 166.6 (SD 9.4)	161.6 (8.8)	161.1 (8.3)	166.6 (8.3)	166.2 (7.4)	168.3 (9.1)	167.6 (8.9)	171.7 (8.9)	174.4 (8.4)
Body weight (kg)	Mean 71.6 (SD 12.5)	69.2 (11.8)	68.6 (11.4)	70.5 (9.9)	67.8 (9.7)	73.6 (14.2)	71.8 (12.5)	74.2 (11.4)	75.1 (9.8)
BMI (kg/m^2)	Mean 25.8 (SD 3.8)	26.5 (4.2)	26.4 (3.9)	25.4 (2.9)	24.5 (2.9)	25.9 (4.3)	25.5 (3.7)	25.1 (2.9)	24.6 (2.3)
Systolic blood pressure (mmHg)	Mean 132.8 (SD 16.7)	133.1 (18.3)	134.4 (17.5)	131.5 (15.6)	125.8 (12.0)	132.6 (16.1)	132.4 (16.4)	133.0 (16.6)	135.3 (14.7)
Diastolic blood pressure (mmHg)	Mean 80.2 (SD 10.7)	80.7 (11.4)	81.2 (10.7)	78.2 (11.0)	72.1 (9.7)	80.7 (10.5)	79.9 (10.3)	80.0 (11.1)	76.5 (12.4)
RHR (beats/min)	Mean 70.8 (SD 12.1)	71.8 (10.5)	70.4 (11.4)	65.5 (11.4)	57.5 (12.8)	73.6 (11.8)	71.6 (12.3)	66.6 (11.8)	56.2 (9.8)
Cholesterol (mmol/l)	Mean 6.52 (SD 1.34)	6.47 (1.29)	6.59 (1.30)	6.56 (1.34)	5.46 (0.90)	6.56 (1.41)	6.56 (1.33)	6.38 (1.33)	5.70 (1.24)
Triglycerides (mmol/l)	Mean 1.82 (SD 1.17)	2.00 (1.29)	1.84 (1.16)	1.83 (1.06)	1.30 (0.60)	1.93 (1.14)	1.77 (1.21)	1.69 (0.97)	1.54 (0.92)
Smokers % (n)	41.1 (1507)	48.0 (171)	35.7 (203)	38.5 (70)	18.2 [4]	52.7 (350)	39.3 (579)	34.8 (129)	3.1 [1]
Treat hypertension % (n)	5.6 (206)	3.9 [14]	6.5 [37]	3.3 [6]	0.0 (0)	6.5 [43]	6.1 (90)	3.8 [14]	6.3 [2]

Data are presented as mean (SD) or % (n).
BMI: body mass index; RHR: resting heart rate

Table 2. Characteristics of participants at follow-up (SAMINOR 1, 2003–2004) by leisure time physical activity level.

	Total	Sami (*n* = 1129)				Non-Sami (*n* = 2542)			
	(*n* = 3671)	Sedentary	Moderate activity	Intermediate activity	Intensive activity	Sedentary	Moderate activity	Intermediate activity	Intensive activity
N (%)		310 (27.5)	676 (59.9)	132 (11.7)	11 (1.0)	593 (23.3)	1548 (60.9)	383 (15.1)	18 (0.7)
Men (%)	1785 (48.6)	134 (25.0)	304 (56.6)	90 (16.8)	9 (1.7)	274 (22.0)	726 (58.2)	231 (18.5)	17 (1.4)
Age (years)	Mean 61.2 (SD 8.6)	61.1 (9.5)	61.4 (8.8)	60.6 (8.7)	58.6 (6.2)	60.5 (9.4)	61.6 (8.1)	60.9 (8.5)	57.2 (9.2)
Body height (cm)	Mean 165.3 (SD 9.5)	160.2 (9.2)	160.6 (8.4)	164.2 (9.0)	164.1 (9.7)	166.2 (9.3)	166.9 (9.1)	169.5 (9.2)	175.2 (9.5)
Body weight (kg)	Mean 76.4 (SD 14.3)	74.9 (14.2)	73.3 (13.5)	74.6 (12.1)	69.0 (6.6)	78.8 (16.0)	76.8 (14.0)	78.3 (13.9)	79.0 (9.6)
BMI (kg/m^2)	Mean 27.9 (SD 4.5)	29.2 (5.4)	28.4 (4.5)	27.7 (4.0)	25.7 (1.6)	28.5 (5.3)	27.5 (4.2)	27.2 (3.9)	25.7 (1.5)
Systolic blood pressure (mmHg)	Mean 136.8 (SD 21.5)	137.6 (22.6)	136.7 (22.2)	137.7 (20.6)	133.4 (23.8)	137.8 (22.0)	136.7 (21.3)	135.4 (20.0)	129.9 (13.2)
Diastolic blood pressure (mmHg)	Mean 76.2 (SD 10.2)	74.9 (10.1)	75.8 (10.4)	78.1 (9.4)	76.6 (9.2)	76.4 (10.6)	76.4 (10.1)	76.0 (10.2)	75.6 (9.2)
RHR (beats/min)	Mean 68.2 (SD 12.0)	69.0 (12.5)	68.4 (11.4)	67.6 (12.2)	61.2 (15.0)	69.5 (12.7)	68.3 (11.8)	66.1 (11.9)	55.6 (9.4)
Cholesterol (mmol/l)	Mean 6.01 (SD 1.15)	5.98 (1.16)	5.93 (1.18)	5.96 (1.33)	6.14 (1.30)	6.00 (1.13)	6.04 (1.13)	6.07 (1.09)	6.09 (0.97)
Triglycerides (mmol/l)	Mean 1.67 (SD 1.02)	1.74 (0.98)	1.67 (0.94)	1.57 (1.08)	1.37 (0.70)	1.85 (1.38)	1.62 (0.90)	1.58 (0.93)	1.26 (0.54)
Smokers % (*n*)	28.3 (1039)	31.2 (96)	27.5 (184)	22.9 [30]	0.0 (0)	35.4 (209)	26.3 (404)	30.0 (114)	11.1 [2]
Treat hypertension % (*n*)	27.0 (991)	32.0 (99)	28.1 (187)	20.0 [26]	30 [3]	31.5 (185)	26.6 (410)	21.3 (81)	0.0 (0)

Data are presented as mean (SD) or % (*n*).
BMI: body mass index; RHR: resting heart rate

Table 3. Associations between change in leisure time physical activity and change in risk factors between baseline (Finnmark 3, 1987–1988) and follow-up (SAMINOR 1, 2003–2004).

	Sedentary in both	Active to sedentary	Sedentary to active	Active in both	
n	422	481	598	2170	*P equality*
BMI (kg/m^2)	2.4 (2.2, 2.7)	2.4 (2.2, 2.6)	2.2 (2.0, 2.4)	2.1 (2.0, 2.2)	0.035
Resting heart rate (beats/min)	−2.3 (−3.3, −1.3)	−2.1 (−3.1, −1.2)	−2.9 (−3.7, −2.0)	−2.6 (−3.0, −2.1)	0.665
Triglycerides (%)[a]	−4.2 (−8.2, −0.1)	−0.8 (−4.6, 3.2)	−8.9 (−12.0, −5.5)	−7.3 (−9.1, −5.6)	0.005
Cholesterol (mmol/l)	−0.64 (−0.74, −0.53)	−0.51 (−0.60, −0.41)	−0.60 (−0.69, −0.52)	−0.46 (−0.51, −0.42)	0.003
Diastolic blood pressure (mmHg) [b]	−4.7 (−5.6, −3.9)	−4.1 (−4.9, −3.3)	−4.3 (−5.0, −3.5)	−3.7 (−4.1, −3.3)	0.133
Systolic blood pressure (mmHg) [b]	4.7 (3.0, 6.4)	4.2 (2.6, 5.8)	3.7 (2.3, 5.2)	3.9 (3.1, 4.6)	0.811

Data are presented as mean change (95% CI) and adjusted for age, smoking habits, sex, ethnicity and baseline values.
BMI: body mass index
[a] Triglyceride values were log transformed and presented as change in percent; [b] Adjusted for anti-hypertensive medication at follow-up.

There were no statistically significant interactions ($p > 0.05$) between ethnicity and change in leisure time physical activity, except for cholesterol, which changed significantly with physical activity in the non-Sami, but not in the Sami group (p for interaction = 0.014). Furthermore, there were no statistically significant interaction between sex and change in leisure time physical activity.

Discussion

In this longitudinal, population-based study over 16 years, we found a lower increase in BMI among those who were active during both surveys compared to those who were persistently sedentary in leisure time. Furthermore, we found that the decrease in triglycerides was more pronounced in the persistently active group than in the persistently sedentary participants. To our surprise, those who were persistently active had the lowest reduction in cholesterol. Otherwise, changes in leisure time physical activity were not reflected in the changes in cardiovascular risk factors of clinical significance. A higher proportion of the Samis compared to non-Samis were sedentary in leisure time; however, ethnicity did not influence the association between leisure time physical activity and cardiovascular risk factors. Our study extends existing knowledge on physical activity and cardiovascular risk factors by exploiting repeated measurements of both physical activity and risk factors.

In general, we found little impact of change in physical activity on change in risk factors, which is somewhat surprising considering the abundance of studies suggesting beneficial effects of physical activity on cardiovascular risk factors and CVD. An explanation may be that the physical activity level and changes are too modest to initiate beneficial effect on the measured risk factors.

We found an increase in BMI over the follow-up period, in accordance with a global trend of increasing BMI over decades, including northern Norway [18,19], which raises concerns considering the relationship with diabetes, cardiovascular diseases and all-cause mortality [20–23]. As expected, we found that BMI increased most among those who were persistently inactive. Anderssen et al. [24] explored the development of BMI from 1972 to 2002 in a Norwegian cohort and found, in accordance with our study, a higher prevalence of obesity among the sedentary compared to people with higher levels of physical activity.

In contrast to the increase in BMI and SBP during follow-up, we found a decrease in RHR, DBP, cholesterol and triglyceride levels. This may be explained by more frequent use of anti-hypertensive medication, statins, etc. at follow-up. Results from this study show an increase in anti-hypertensive medication from about 5% at baseline to nearly 28% at follow-up. However, adjustment for anti-hypertensive medication did not influence the results. We do not have information about any changes in the use of statins, but it seems likely that the use of statins has increased during follow-up as well.

RHR is affected by numerous factors, including genetics and physical fitness [25], and engaging in regular physical activity is associated with lower RHR [26]. In the present study, RHR decreased over time, but the decrease was not associated with change in leisure time physical activity levels. The decrease in RHR from 1987 to 2003–2004 shown in the present study is in accordance with results from the Tromsø Study (1986–2007) [27]. Sharashova et al. [27] found a considerable decline in RHR for men and women, and this development was partly related to changes in cardiovascular risk factors such as SBP, triglycerides, increased physical activity, blood pressure medication and smoking cessation.

Present knowledge supports that physical activity and exercise have a positive impact on lipids, although often a small effect [28]. This is consistent with the present study, where triglycerides decreased most among those who increased their activity level or were persistently active. Nevertheless, an active lifestyle is recommended to patients with abnormal lipids [29].

We found a reduction in DBP over time, while SBP, on the other hand, increased. This is in accordance with data from NHANES III [30], showing that average SBP in the US population increased throughout life, while DBP decreased after 60 years of age. The American College of Sports Medicine recommends dynamic aerobic endurance training for at least 30 min daily to prevent hypertension [31], and randomized control studies repeatedly show that exercise reduces SBP and DBP [32]. There seems to be strong evidence for an effect of physical activity interventions on blood pressure not only among hypertensive but also among normotensive and prehypertensive individuals [33]. However, in our study we found no association between change in leisure time physical activity and blood pressure.

We have previously shown that Sami men and women in the 1980s were more physically active at work and thus had a higher total physical activity score than Norse men and women [34]. In the present study, a higher proportion of the Sami compared to non-Sami were inactive in leisure time in both surveys. However, we do not have comparable measures on occupational physical activity at follow-up, and the results from this study are solely based on leisure time physical activity, making it hard to draw conclusions on trends in total physical activity. The traditional Sami way of living, with a major engagement in the primary industries, has changed over the last decades, the Sami society is modernized and mechanization has most likely entailed less occupational physical activity. From 1980 to 2000, the prevalence of Samis working in primary industry decreased from 20% to 12% [35]. Thus, one would expect that the total physical activity level among Samis gradually would approach the level of the non-Samis. At follow-up, there were no differences in RHR between Sami and non-Sami, supporting the assumption that the level of physical activity between the two groups over time have become more comparable. The same trend with Westernization and urbanization is seen among the Canadian and Greenland Inuit; since 1950, a gradual transition from a traditional lifestyle characterized of hunting and fishing to a more sedate lifestyle with reduced physical activity and less favourable cardiovascular risk factors was observed [36,37].

This study has limitations. Even with a participation rate of 78% in Finnmark 3 and 63% in SAMINOR 1, individuals with poor health were presumably underrepresented, introducing potential selection bias. However, bias due to non-participation is probably of less concern in prospective studies [38,39], because the outcome is not known at baseline and will not affect the way participants respond to the questionnaire. Moreover, the use of self-reported physical activity has most likely introduced misclassification errors. Given that people tend to overestimate their activity level [40], misclassification will probably underestimate the real effects of physical activity [41]. The validity of our physical activity questions has been ensured in several studies [40,42], and physical activity according to the questionnaire was found to be positively associated with objectively measured physical activity and physical fitness in a dose–response relationship [40].

Moreover, lack of information about medications such as β-blockers and lipid lowering drugs could bias our results, especially if the prevalence of these drugs were different in ethnic groups. However, Sami and non-Sami in this study have a very similar cardiovascular risk profile both at baseline and follow-up and we have no clear indications that there is a skewness between these groups in medication.

Pettersen et al. [43] have challenged the concept of ethnicity, which is a complex topic. The inclusion criteria and definition have impacts on the size of the study population. Different definitions of ethnicity were used in the Finnmark 3 Study and SAMNIOR 1; the latter has somewhat broader definition and is now widely used, and was therefore the chosen definition in the present study.

This cohort study with a prospective design and 16 years of follow-up has the advantage of being one of few studies with repeated measurements of both leisure time physical activity and cardiovascular risk factors. Furthermore, this is to our knowledge the first study highlighting this topic of association between changes in leisure time physical activity and cardiovascular risk factors in the Arctic region of Norway.

Conclusions

In this longitudinal cohort study, being persistently physically active over a 16-year period was reflected in a lower increase in BMI than being sedentary. In addition, the decrease in triglyceride levels was more pronounced in the persistently active group than in the persistently sedentary group. Otherwise, the impact of change in physical activity on cardiovascular risk factors was minor and clinically insignificant. The Sami participants were more sedentary than the non-Sami; however, there were few ethnic differences in the association between leisure time physical activity and cardiovascular risk factors.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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Statement of human rights

This study was approved by the Regional Committee for Medical Research Ethics in Northern Norway the 09.01.2014 (REK nr. 2013/2249) and was performed in accordance with ethical standards as laid down in the 1964 Declaration of Helsinki and later amendments.

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Paper 3

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Leisure time and occupational physical activity, resting heart rate and mortality in the Arctic region of Norway: The Finnmark Study

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Abstract

Aims: This study examined the association of leisure time physical activity, occupational physical activity, and resting heart rate with all-cause and cardiovascular disease mortality in Sami and non-Sami populations.

Study design: This was a longitudinal, observational population-based study.

Methods: The Finnmark 3 study cohort was examined in 1987–1988 and followed for all-cause and cardiovascular disease mortality for 26 years. The cohort included 17,697 men and women with a mean age of 47.2 years at baseline. Leisure time physical activity and occupational physical activity were assessed with a validated questionnaire at baseline, whereas cause of death was obtained from the Norwegian Cause of Death Registry.

Results: A total of 1983 women and 3147 men died during follow-up. Leisure time physical activity was linearly and inversely associated with all-cause mortality, but not coronary heart disease mortality. Compared to inactive subjects, all-cause mortality was significantly reduced by 16% in the active leisure time physical activity group (hazard ratio 0.84; 95% confidence interval 0.76–0.92). Both for all-cause and cardiovascular disease mortality, we observed a U-shaped relationship with occupational physical activity, as participants in the walking and lifting group had significantly lower mortality than both the mostly sedentary and the heavy manual labour group ($p < 0.05$). An increase in resting heart rate by one beat per minute was associated with a 1.1% increase in all-cause mortality (hazard ratio 1.011; 95% confidence interval 1.009–1.013). The associations were similar in Sami and non-Sami subjects.

Conclusion: In this population-based study, leisure time physical activity was inversely associated with all-cause mortality, whereas resting heart rate was positively associated with all-cause and cardiovascular disease mortality. There was a U-shaped association between occupational physical activity and cardiovascular disease and all-cause mortality.

Keywords

Physical activity, heart rate, ethnicity, indigenous, longitudinal, mortality, Sami

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Introduction

The importance of regular physical activity to reduce the risk of cardiovascular disease (CVD) and death is well established.[1–3] Both physical activity[1,4] and exercise capacity[5,6] are inversely related to mortality. However, a majority of previous studies have included only leisure time physical activity (LTPA),[1,4] and the association between occupational physical activity (OPA) and mortality is less studied. Some studies suggest that high levels of OPA are associated with increased mortality, particularly among men,[7–9]

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whereas other studies show benefits of high levels of OPA.[10,11] Moreover, high levels of OPA in combination with low cardiorespiratory fitness seem to be associated with increased CVD mortality.[12]

When direct measures of exercise capacity are lacking, resting heart rate (RHR), which is an easily accessible clinical variable, may act as a proxy for physical fitness and physical activity in large cohorts.[13,14] Findings indicate that high RHR is independently associated with increased all-cause and cardiovascular mortality,[15] and development of atherosclerosis.[16] However, the independent role of RHR for mortality is disputed.[15]

We address these issues in a large cohort of men and women in Finnmark County in northern Norway, which is characterised by a large minority of indigenous Sami people. Historically, Finnmark county has had the highest mortality rates and incidence of coronary heart disease in Norway. The life expectancy for the population is still somewhat lower than the average in Norway, but the gap is slowly diminishing.[17] We have previously shown that the Sami population has higher work physical activity levels and lower RHR than their Norwegian peers,[18] which could suggest possible ethnic interactions in the association between physical activity and mortality.

The main aim of this study was to examine the associations of LTPA, OPA and RHR with all-cause and CVD mortality. Additionally, we wanted to examine whether these associations differed between Sami and non-Sami populations.

Methods

The Finnmark Study

The Finnmark Study is a longitudinal, population-based study in northern Norway conducted in 1974–1975 (Finnmark 1), 1977–1978. (Finnmark 2), and 1987–1988 (Finnmark 3).[19,20] The present analyses are based on data from the third Finnmark Study in 1987–1988, to which all residents in Finnmark County aged 40–62 years (born 1925–1947) were invited, together with a subsample among inhabitants aged 20–39 (born 1948–1967) (those invited to Finnmark 2 still living in Finnmark and 10% of those who were not invited to Finnmark 2). In total, 22,941 inhabitants were invited, and 17,821 men and women (77.7%) attended Finnmark 3. Invitations were sent by letter and the participants were asked to answer three questionnaires, which were presented in Norwegian and Sami languages. Participation rate increased with age and women had higher participation rates than men. Moreover, participation varied by community.[20]

Selected sample for the present analyses

The present sample includes 17,697 men and women, aged 20–62 years at examination, with valid data on physical activity and covariates. Of these, 13,590 participants reported ethnic affiliation, among which 2813 (20.7%) were categorised as Sami and 10,777 (79.3%) as non-Sami, constituting a subsample.

Exposure assessment

LTPA levels at baseline were assessed by the Saltin-Grimby Physical Activity Level Scale[21] with four mutually exclusive options. Due to a low number of participants ($n = 224$) answering the highest physical activity option, groups 3 and 4 were merged, leaving three groups for the analyses: ‘inactive’, ‘moderate’ (walking, bicycling, etc. $\geq$ 4 h a week) and ‘active’ (recreational sports etc. $\geq$ 4 h a week or hard training or competitions several times a week).

OPA levels at baseline were also assessed by the Saltin-Grimby Physical Activity Level Scale[21] with four mutually exclusive options: ‘mostly sedentary’, ‘walking’ (e.g. shop assistant, light industrial work, education), ‘walking and lifting’ (e.g. mailman, heavy industrial work, construction work) and ‘heavy manual labour’ (e.g. forestry work, heavy agriculture work, heavy construction work).

LTPA measured by the Saltin-Grimby Physical Activity Level Scale[21] shows satisfactory rank validity when validated against maximal oxygen uptake (VO_{2max}) and accelerometry.[13] In contrast to LTPA, no association between self-reported OPA and VO_{2max} was observed.[13]

RHR was measured during blood pressure monitoring (Dinamap, Criticon), sitting down after four minutes rest. Three measurements were taken with an interval of one minute, and the lowest of the three heart rate measurements was used in the analyses.

Covariates

Age was obtained from the National Population Registry. Data on daily smoking, previous CVDs (myocardial infarction, angina pectoris, stroke), diabetes mellitus, and treatment for hypertension was self-reported (yes/no). Non-fasting blood samples were collected and analysed for serum total cholesterol and triglycerides using an enzymatic method (Hitachi Auto Analyser, Roche Diagnostic, Switzerland). Height and weight of all subjects were measured by the screening nurse and recorded. Systolic and diastolic blood pressure (SBP and DBP) levels were measured automatically with the Dinamap (Criticon) blood pressure monitor.[22] Three measurements were taken with an interval of one minute, and the mean value of the second and third measurements of blood pressure was used in the present analyses.

Ethnicity was dichotomised from four original categories into Sami (original categories Sami or Finnish/Sami) and non-Sami (original categories Norwegian or Finnish).[20] Classification was based on the two questions: 'Are two or more of your grandparents of Sami origin?' and 'Are two or more of your grandparents of Finnish origin?' as shown in Supplemental Material Table S1. Those who responded 'unknown' were classified as missing.

Cause of death

Date and cause of death in the analytical cohort from date of attendance in 1987–1988 through 31 December 2013 were registered. CVD death was defined as International Classification Of Diseases (ICD)-9: 390–459 codes and ICD-10: I00–I99, using the underlying cause of death.

Statistical analysis

The associations of LTPA, OPA and RHR with CVD and all-cause mortality were estimated by Cox proportional hazard models with days-to-event as the time axis, with hazard ratio (HR) and 95% confidence interval (CI) as effect size. Proportional hazard assumptions were assessed by inspecting the log (-log) survival curves for the various physical activity categories. Model 1 tested the association between either LTPA, OPA or RHR as exposure and all-cause or CVD mortality as outcome, adjusted for age, sex, smoking status and body mass index (BMI) categories. Associations between LTPA and mortality were additionally adjusted for OPA, and vice versa. The model of RHR and mortality did not include OPA or LTPA. In Model 2, we additionally adjusted for self-reported angina pectoris, myocardial infarction, cerebral insult, diabetes and anti-hypertensive medication, which represent possible mediators in the association between physical activity and mortality. The analyses were repeated in a subsample ($n = 13,590$) with valid data on ethnicity, stratified by Sami or non-Sami.

By adding multiplicative interaction terms to the main multivariable models in Cox proportional hazard model, we assessed possible interactions between sex and LTPA, sex and OPA, ethnicity and LTPA, ethnicity and OPA, sex and RHR, ethnicity and RHR, and finally between LTPA and OPA, with OPA treated as a quadratic term. Values of p were two-sided with a significance level of 0.05. Data analyses were performed using IBM SPSS Statistics, version 24 (IBM Corporation, Armonk, New York, USA).

Ethical permission

The Norwegian Data Inspectorate approved the Finnmark Study. The present study was approved by the Regional Committee for Medical Research Ethics in Northern Norway (REK no. 2013/2249).

Results

In total, 17,697 participants with a mean age of 47.2 years at baseline were included in the analyses. During a mean of 23.3 years of follow-up, 5130 participants (1983 women and 3147 men) died, of which 1764 were due to CVD. The crude mortality rate was 12.2 per 1000 person-years.

Table 1 shows the characteristics of the study population at baseline (Finnmark 3, 1987–1988) by LTPA and OPA. Compared with the non-Sami, a higher percentage of the Sami were categorised as inactive in leisure time ($p = 0.01$), whereas the Sami were more active at work ($p < 0.001$). Values of BMI, DBP, treatment for hypertension and RHR decreased significantly with increasing levels of LTPA.

LTPA and mortality

We found an inverse linear association between LTPA and all-cause mortality after adjustments ($p < 0.001$) (Table 2, Model 1). Moderate LTPA was associated with a non-significant reduction in all-cause mortality, compared with the inactive group (HR 0.95; 95% CI 0.89–1.01; Model 1), and participants in the active LTPA group had 16% reduced risk (HR 0.84; 95% CI 0.76–0.92; Model 1). These inverse associations were slightly attenuated with further adjustment in Model 2, and found both in Sami and non-Sami subjects (Table 2). A non-significant inverse, linear association between LTPA and CVD mortality was observed in both Model 1 and 2 (Table 2). There were no interactions between sex or ethnicity and LTPA in any of the models. However, an interaction between LTPA and OPA was observed ($p < 0.001$), as mortality decreased with increasing LTPA in the two lowest OPA categories; however, in the two highest levels of OPA, LTPA did not seem to influence mortality (Supplemental Material Table S2).

OPA and mortality

The association of OPA with all-cause and CVD mortality was U-shaped (Table 3). Compared with the subjects with walking and lifting OPA, we found a 16% higher all-cause mortality in the mostly sedentary OPA group (HR 1.16; 95% CI 1.07–1.26; Model 1) and a 13% higher mortality in the heavy manual labour

Table 1. Participant characteristics at baseline by leisure time and occupational physical activity: The Finnmark Study.

		Leisure time physical activity ($n = 17{,}697$)				Occupational physical activity ($n = 17{,}697$)				
	Overall	Inactive	Moderate	Active	p for linear trend[a]	Mostly sedentary	Walking	Walking and lifting	Heavy manual labour	p for linear trend[a]
Overall (%)	17,697 (100)	4684 (26.5)	10431 (58.9)	2582 (14.6)		5767 (32.6)	6729 (38.0)	3679 (20.8)	1522 (8.6)	
Sex					<0.001					<0.001
Men (%)	8951 (50.6)	2316 (25.9)	4764 (53.2)	1871 (20.9)		3221 (36.0)	2387 (26.7)	2021 (22.6)	1322 (14.8)	
Women (%)	8746 (49.4)	2368 (27.1)	5667 (64.8)	711 (8.1)		2546 (29.1)	4342 (49.6)	1658 (19.0)	200 (2.3)	
Age (years)	47.2 (9.2)	46.5 (9.2)	47.9 (9.2)	45.3 (9.4)	0.014	47.2 (9.1)	47.9 (9.2)	45.8 (9.4)	47.2 (8.9)	<0.001
Ethnicity[b]					0.012					<0.001
Non-Sami (%)	10777 (79.3)	2682 (24.9)	6523 (60.5)	1572 (14.6)		3778 (35.1)	4111 (38.1)	2138 (19.8)	750 (7.0)	
Sami	2813 (20.7)	832 (29.6)	1533 (54.5)	448 (15.9)		790 (28.1)	1033 (36.7)	638 (22.7)	352 (12.5)	
Body height (cm)	167.3 (9.3)	166.8 (9.4)	166.8 (9.2)	170.6 (9.1)	<0.001	168.8 (9.4)	165.3 (9.2)	167.5 (9.1)	170.5 (8.3)	0.287
Body weight (kg)	72.5 (13.2)	73.2 (14.3)	71.8 (13.0)	73.8 (11.5)	0.700	73.7 (13.6)	70.6 (13.0)	72.6 (12.7)	75.9 (12.0)	0.010
BMI (kg/m^2)	25.8 (4.0)	26.3 (4.5)	25.8 (3.9)	25.3 (3.1)	<0.001	25.8 (4.0)	25.8 (4.2)	25.8 (3.9)	26.1 (3.4)	0.015
Systolic blood pressure (mm Hg)	135.4 (18.5)	135.2 (18.5)	135.7 (18.8)	134.5 (17.0)	0.979	134.7 (18.4)	135.5 (19.1)	135.0 (17.7)	138.4 (18.1)	<0.001
Diastolic blood pressure (mm Hg)	81.4 (11.3)	81.9 (11.3)	81.6 (11.3)	79.9 (10.8)	<0.001	81.8 (11.2)	81.1 (11.3)	80.9 (11.0)	82.3 (11.5)	0.587
RHR (beats/min)	72.7 (13.1)	74.7 (13.0)	73.0 (12.9)	67.7 (12.5)	<0.001	72.5 (13.3)	73.2 (13.1)	72.6 (12.7)	71.2 (12.5)	0.040
Cholesterol (mmol/l)	6.59 (1.36)	6.59 (1.37)	6.63 (1.36)	6.42 (1.36)	0.002	6.53 (1.35)	6.61 (1.37)	6.55 (1.38)	6.79 (1.34)	<0.001
Triglycerides (mmol/l)[c]	1.86 (1.30)	1.97 (1.47)	1.83 (1.24)	1.80 (1.21)	<0.001	1.89 (1.20)	1.79 (1.33)	1.88 (1.37)	2.00 (1.36)	0.054
Smokers (%)	8721 (49.3)	2698 (57.6)	4963 (47.6)	1060 (41.1)	<0.001	2818 (48.9)	3071 (45.6)	1968 (53.5)	864 (56.8)	<0.001
Hypertension treatment (%)	1393 (7.9)	422 (9.0)	852 (8.2)	119 (4.6)	<0.001	493 (8.5)	570 (8.5)	233 (6.3)	97 (6.4)	0.001
Myocardial infarction (%)	327 (1.8)	90 (1.9)	210 (2.0)	27 (1.0)	0.042	145 (2.5)	118 (1.8)	42 (1.1)	22 (1.4)	<0.001
Angina pectoris (%)	710 (4.0)	192 (4.1)	466 (4.5)	52 (2.0)	0.001	271 (4.7)	296 (4.4)	96 (2.6)	47 (3.1)	<0.001
Cerebral insult (%)	125 (0.7)	37 (0.8)	74 (0.7)	14 (0.5)	0.277	57 (1.0)	53 (0.8)	9 (0.2)	6 (0.4)	<0.001
Diabetes mellitus (%)	234 (1.3)	78 (1.7)	136 (1.3)	20 (0.8)	0.002	91 (1.6)	96 (1.4)	33 (0.9)	14 (0.9)	0.008

BMI: body mass index; RHR: resting heart rate; SD: standard deviation.
Data are presented as mean (SD) or number (%).
[a]Age-adjusted; [b]$n = 13{,}590$; [c]triglycerides were log transformed when computing the p-value.

Table 2. All-cause and cardiovascular mortality by self-reported leisure time physical activity: The Finnmark Study.

	n	*n* Deaths	Model 1 HR (95% CI)	Model 1 *p* for linear trend	Model 2 HR (95% CI)	Model 2 *p* for linear trend
All-cause mortality						
Overall	17,697	5130		<0.001		0.009
Inactive	4684	1392	1.0		1.0	
Moderate	10,431	3126	0.95 (0.89–1.01)		0.96 (0.90–1.02)	
Active	2582	612	0.84 (0.76–0.92)		0.87 (0.79–0.96)	
Non-Sami[a]	10,777	3035		0.001		0.010
Inactive	2682	789	1.0		1.0	
Moderate	6523	1907	0.94 (0.86–1.02)		0.94 (0.87–1.03)	
Active	1572	339	0.80 (0.71–0.91)		0.84 (0.74–0.96)	
Sami[a]	2813	815		0.188		0.252
Inactive	832	244	1.0		1.0	
Moderate	1533	449	0.92 (0.79–1.08)		0.94 (0.80–1.10)	
Active	448	122	0.87 (0.69–1.09)		0.88 (0.70–1.10)	
Cardiovascular mortality						
Overall	17,697	1764		0.240		0.816
Inactive	4684	471	1.0		1.0	
Moderate	10,431	1070	0.96 (0.86–1.08)		0.99 (0.88–1.10)	
Active	2582	223	0.91 (0.77–1.07)		0.98 (0.84–1.16)	
Non-Sami[a]	10,777	999		0.141		0.381
Inactive	2682	260	1.0		1.0	
Moderate	6523	623	0.95 (0.82–1.10)		0.95 (0.82–1.11)	
Active	1572	116	0.84 (0.67–1.05)		0.91 (0.73–1.14)	
Sami[a]	2813	311		0.759		0.640
Inactive	832	88	1.0		1.0	
Moderate	1533	168	0.96 (0.74–1.26)		0.98 (0.75–1.28)	
Active	448	55	1.08 (0.76–1.53)		1.11 (0.78–1.58)	

BMI: body mass index; CI: confidence interval; HR: hazard ratio.
Model 1: Adjusted for age, sex, smoking status, BMI and occupational physical activity. Model 2: Adjusted for age, sex, smoking status, BMI, self-reported angina pectoris, myocardial infarction, cerebral insult, diabetes, anti-hypertensive medication and occupational physical activity.
[a]$n = 13590$.

group (HR 1.13; 95% CI 1.01–1.26; Model 1) (Table 3). These associations were almost unchanged after further adjustments for CVD, diabetes and anti-hypertensive medication (Model 2, Table 3). The strength of the relationships was similar in Sami and non-Sami subjects.

There were no interactions with sex and ethnicity in any of the models. However, an interaction between OPA and LTPA was observed ($p < 0.001$). When stratifying by LTPA levels, the overall U-shaped association between OPA and mortality was found in the inactive and moderate LTPA groups. However, in the highest LTPA group (Active), we observed a different pattern, with a linearly increasing mortality with increasing OPA level (Supplemental Material Table S2).

RHR and mortality

All-cause mortality increased by 1.1% for each beat per minute increase in RHR (HR 1.011; 95% CI 1.009–1.013; Model 1). Similar results were observed for CVD mortality (HR 1.007; 95% CI 1.004–1.011; Model 1), and after further adjustments for CVD and diabetes. These trends were seen in both ethnic groups. There were no interactions between sex or ethnicity and RHR in any of the models.

Discussion

In this prospective study over 26 years, LTPA reduced all-cause mortality in a linear dose-response relationship, whereas the association between LTPA and

Table 3. All-cause and cardiovascular mortality by self-reported occupational physical activity: the Finnmark Study.

			Model 1		Model 2	
	n	*n* Deaths	HR (95% CI)	*p* For non-linear trend	HR (95% CI)	*p* For non-linear trend
All-cause mortality						
Overall	17,697	5130		0.003		0.020
Mostly sedentary	5767	1758	1.16 (1.07–1.26)		1.13 (1.04–1.22)	
Walking	6729	1915	1.11 (1.03–1.20)		1.08 (1.00–1.17)	
Walking and lifting	3679	924	1.0		1.0	
Heavy manual labour	1522	533	1.13 (1.01–1.26)		1.14 (1.02–1.27)	
Non-Sami	10,777	3035		0.052		0.073
Mostly sedentary	3778	1125	1.15 (1.04–1.28)		1.14 (1.03–1.26)	
Walking	4111	1130	1.09 (0.98–1.21)		1.08 (0.97–1.20)	
Walking and lifting	2138	530	1.0		1.0	
Heavy manual labour	750	250	1.14 (0.98–1.32)		1.16 (1.00–1.35)	
Sami	2813	815		0.167		0.371
Mostly sedentary	790	242	1.19 (0.97–1.45)		1.14 (0.93–1.39)	
Walking	1033	282	1.23 (1.01–1.50)		1.16 (0.95–1.42)	
Walking and lifting	638	158	1.0		1.0	
Heavy manual labour	352	133	1.25 (0.99–1.58)		1.21 (0.96–1.53)	
Cardiovascular mortality						
Overall	17,697	1764		0.013		0.160
Mostly sedentary	5767	634	1.26 (1.10–1.45)		1.17 (1.02–1.34)	
Walking	6729	640	1.18 (1.02–1.35)		1.09 (0.95–1.25)	
Walking and lifting	3679	298	1.0		1.0	
Heavy manual labour	1522	192	1.14 (0.95–1.36)		1.15 (0.96–1.38)	
Non-Sami[a]	10,777	999		0.064		0.216
Mostly sedentary	3778	395	1.27 (1.06–1.52)		1.20 (1.00–1.44)	
Walking	4111	356	1.13 (0.94–1.36)		1.08 (0.90–1.30)	
Walking and lifting	2138	166	1.0		1.0	
Heavy manual labour	750	82	1.10 (0.85–1.44)		1.14 (0.87–1.49)	
Sami[a]	2813	311		0.612		0.856
Mostly sedentary	790	88	1.06 (0.76–1.46)		0.95 (0.68–1.32)	
Walking	1033	106	1.22 (0.89–1.69)		1.07 (0.78–1.48)	
Walking and lifting	638	63	1.0		1.0	
Heavy manual labour	352	54	1.12 (0.78–1.62)		1.06 (0.73–1.54)	

BMI: body mass index; CI: confidence interval; HR: hazard ratio.
Model 1: Adjusted for age, sex, smoking status, BMI and leisure time physical activity. Model 2: Adjusted for age, sex, smoking status, BMI, self-reported angina pectoris, myocardial infarction, cerebral insult, diabetes, anti-hypertensive medication and leisure time physical activity.
[a]$n = 13{,}590$.

CVD mortality was not statistically significant. We found a U-shaped association between OPA and all-cause and CVD mortality, with moderate OPA levels associated with the lowest mortality. Furthermore, we found a linear relationship between RHR and all-cause and CVD mortality. The association of LTPA, OPA and RHR with mortality did not differ between the Sami and non-Sami populations.

LTPA and mortality

Numerous studies have demonstrated an inverse association between LTPA level and all-cause mortality,[1,4,23] showing a 10–40% risk reduction with moderate physical activity. In the present study, participants with the highest LTPA level benefited most, as hard training of at least four hours a week showed a 16% reduction in all-cause mortality compared to the non-significant 5% risk reduction in the moderate LTPA group. Our finding that LTPA is associated with reduced mortality in a dose-response manner is also in accordance with results from pooled data from six studies in the National Cancer Institute Cohort Consortium[1] and a meta-analysis of 22 cohort studies.[24] One possible explanation for this finding could be better general health and socioeconomic status (SES) in the groups with the highest LTPA levels. Unfortunately, data concerning SES were not available. On the other hand, numerous studies show strong evidence for an inverse and independent association between LTPA and mortality, supporting our findings.

Interestingly, decreasing mortality with increasing LTPA was only found in the two lowest OPA categories; in higher levels of OPA, LTPA did not seem to influence mortality (Supplemental Material Table S2).

The weaker association between LTPA and CVD mortality compared to all-cause mortality is in contrast to other studies.[1,3] One possible explanation could be low statistical power. Moreover, high prevalences of CVD in the Arctic region[25] may have influenced the effect of physical activity on CVD mortality in this population.[26]

OPA and mortality

We found a 13–16% lower all-cause mortality in the walking and lifting group compared with the sedentary OPA group and the heavy manual labour group, suggesting a U-shaped association between OPA and mortality. However, this U-shape was found only in the inactive and moderate LTPA groups, whereas participants in the active LTPA groups showed a linearly increasing mortality with increasing OPA level.

The Danish National Work Environment Cohort study[7] observed an increasing all-cause mortality with increasing OPA in men, whereas female workers showed a U-shaped association. The association between OPA and mortality is inconsistent in cohort studies, although many indicate an increased mortality rate among those with high OPA. This has led researchers to propose a 'physical activity paradox',[27] suggesting that OPA and LTPA have opposite effects on CVD health and mortality. Possible reasons for this include the characteristics of OPA, such as low intensity, long duration, static postures and heavy lifting. Furthermore, OPA may elevate 24-hour heart rate and blood pressure.[27]

RHR and mortality

Our finding that high RHR is related to a significant increase in all-cause and CVD mortality is in accordance with findings from several meta-analyses and large cohort studies showing that elevated RHR is independently associated with increased of all-cause and cardiovascular mortality,[15,28,29] even when controlling for familial factors.[30] A study showing that high RHR trajectories were associated with the highest risk of death, although only in men, further highlights these findings.[31] A plausible explanation for the increased mortality risk with higher RHR is dysfunctional autonomic nervous activity[15] and detrimental effects on the progression of atherosclerosis caused by higher RHR.[16]

Physical activity and mortality in Sami and non-Sami populations

The associations between physical activity and mortality did not differ with ethnicity in our study. In the 1980's, the percentage of employees in primary industries (reindeer industry, agriculture and fishing) was approximately 20% among the Samis compared to about 8% amongst the population at large.[32] However, the numbers of employees in the reindeer industry decreased by 16% from 1990 to 2008,[33] indicating that the industries of the Sami and non-Sami populations became more similar during follow-up. This may have levelled out the differences in physical activity and RHR found between the Sami and non-Sami populations in 1986–1987.[18] In addition, the Sami and non-Sami populations seem to be rather homogeneous regarding lifestyle and CVD risk factors.[34,35] To our knowledge, no previous studies have examined the association between physical activity and mortality among other indigenous peoples.

Limitations and strengths

Self-reported physical activity may be subject to misclassification errors. We did not have updated information on the exposure variables, which could lead to misclassification due to changes in exposure during follow-up. Moreover, we did not have information about SES. Physical activity levels increase with education level,[36] and higher social class is often associated with longevity,[37] thus introducing SES as potential confounder that could explain some of the association between physical activity and mortality. Moreover, the observed associations could be influenced by unmeasured confounders such as diet and genotype.

The strengths of this cohort study are the prospective design with 26 years follow-up time in a population with a large Sami minority, a large number of mortality cases and minimal loss to follow-up. The study involves rigorous outcome ascertainment, with a high degree of completeness of the Norwegian Cause of Death Registry, covering about 98% of all deaths in

Norway.[38] The validity of CVD mortality in Norway shows substantial agreement with autopsy findings.[39]

Conclusion

In this population-based study, LTPA was inversely associated with all-cause mortality, whereas a U-shaped association was observed between OPA and CVD and all-cause mortality. Elevated RHR was associated with higher all-cause and CVD mortality. The findings applied to both the Sami and non-Sami populations.

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Author contribution

RH, BM and BKJ contributed to the design, statistical analysis and drafting of the manuscript. RH, BM, BKJ and MLL revised the manuscript critically. All of the authors approved the manuscript for publication and are accountable for all aspects of the work.

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Supplemental table S1: Classification of ethnicity. The Finnmark Study 1987-88

(n=13590)

	Are two or more of your grandparents of Finnish origin? Yes	Are two or more of your grandparents of Finnish origin? No
Are two or more of your grandparents of Sami origin? Yes	Sami (original category Finnish/Sami)	Sami (original category Sami)
Are two or more of your grandparents of Sami origin? No	Non-Sami (original category Finnish)	Non-Sami (original category Norwegian)

Sami: n=2813 (20.7%)
Non-Sami (Norwegian, Finnish): n=10777 (79.3%)

Supplemental table S2: *HR for mortality for combined LTPA and OPA categories, adjusted for age, sex, smoking, and BMI*

	OPA 1 (Sedentary)	OPA 2 (Walking)	OPA 3 (Walking and lifting)	OPA 4 (Heavy manual labour)
LTPA 1 (Inactive) HR (95.0% CI) **N (n deaths)**	1.29 (1.08, 1.55) 1897 (632)	1.15 (0.95, 1.40) 1584 (441)	0.89 (0.72, 1.11) 847 (194)	1.12 (0.88, 1.43) 356 (125)
LTPA 2 (Moderate) HR (95.0% CI) **N (n deaths)**	1.14 (0.95, 1.36) 3114 (971)	1.10 (0.92, 1.31) 4330 (1275)	1.01 (0.84, 1.21) 2210 (589)	1.06 (0.87, 1.30) 777 (291)
LTPA 3+4 (Active) HR (95.0% CI) **N (n deaths)**	0.82 (0.66, 1.04) 756 (155)	0.95 (0.77, 1.18) 815 (199)	1.0 (Ref) 622 (141)	1.17 (0.91, 1.49) 389 (117)

*Reference category is Active LTPA (cat. 3+4) and Walking and lifting OPA (cat 3) which showed the lowest HR when testing main effects.

Appendix A

Questionnaire Finnmark 3, 1987-88

MELDING OM HJERTE- KARUNDERSØKELSE

(Gjelder bare den person som brevet er adressert til.)

Hjerte- karundersøkelsen kommer nå til Deres distrikt.

Tid og sted for frammøte vil De finne nedenfor.

De finner en orientering om undersøkelsen i den vedlagte brosjyren.

Vi ber Dem vennligst fylle ut spørreskjemaet på baksiden og ta dette med til undersøkelsen.

Vi ber Dem eventuelt melde fra om fraværet på den vedlagte fraværsmeldingen.

Med hilsen

KOMMUNEHELSETJENESTEN FYLKESLEGEN
STATENS HELSEUNDERSØKELSER

Født dato	Personnr.	Kommune	Kretsnr.

Møtested	Kjønn	Første bokstav i etternavn	Dag og dato	Klokkeslett

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

(JA / NEI)

Røyker De daglig for tiden? 30

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 serutter/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

(JA / NEI)

Har De i løpet av de siste 12 måneder fått arbeidsledighetstrygd? 51

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.)

(JA / NEI)

Er husmorarbeid hovedyrket Deres? 56

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

Sami translation of the questionnaire

DIEĐÁHUS VÁIBMOSIVVA–GEAHČADEAMI BIRRA

(Guoská dušše sutnje geasa breva lea čállojuvvon)

Váibmosivva-geahčadeapmi boahtá du báikái.

Goas ja gosa galggat boahtit gávnnat sierra šemas mii čuovvu mielde.

Geahčadeami birra leat čilgen mielčuovvu brošyras.

Mii bivdit du deavdit jearahallanšema mii lea dás duogábealde ja dasto váldit dan dan mielde geahčadeapmái.

Geahpedan dihtii doaimmahaga, de ávžžuhat du váldit mielde dárogiel (girjegiel) teavstta gos du namma ja riegádanbeaivi čuožžu.

Jos leat hehttejuvvon boahtimis, de fertet dieđihit mielčuovvu «jávkansiva-dieđáhusas».

Dearvuođaiguin

Gielddadearvvasvuođa-ásahus

Fylkkadoavttir

Statens helseundersøkelser
(Stáhta dearvvasvuođa-geahčadeamit)

Namma

Riegádanbeaivi

Persssonnummir

Ruovttuobáikki gielda

A BEARAŠ

Juo | Ii | In diede

Lea go du váhnemiin dahje oappáin/vielljain leamaš váibmo-dohppehallan (hávvi váimmus) dahje angina pectoris (váibmo-krámpa)? 12

B IEŽAT DÁVDA

Lea go dus dahje lea go leamaš:
Váibmo-dohppehallan? 13
Angina pectoris (váibmo-krámpa)? 14
Vuoiŋŋas-šlága? 15
Sohkardávda 16

Leat go don dálkkodeami vuolde
Alla varradeattu dihtii 17

Geavahat go:
Nitroglyseriinna 18

C DOVDOMEARKKAT

Juo | Eai/Ii

Leat go dus bákčasat dahje unohisvuohta rattis go
váccát vuostálagaide, ráidalasas dahje váhccát johtilit duolbbážis? 19
Váccát dábálaččat duolbbážis 20

Maid don lávet dahkat go oaččut bákčasiid dahje unohisvuođa go váccát:
Bisánit? ..... 21 — 1
Unnidit leavttu? 2
Váccát seamma leavttuin? 3

Go bisánat dahje unnidat leavttu jávket go bákčasat
10 minuvtta siste ..... 22 — 1
Váldá eambbo go 10 minuvtta 2

Juo | Ii

Lea go dus dábálaččat:
iditgosahat? 23
rattis šliivi iđđedis 24

D LÁŠMMOHALLAN

Lihkadallan ja rumašlaš bargu friijaáiggis.
Jos doaimmain leat stuorra erohusat omd. geasi ja dálvvi gaskka, de fertet váldit gaskameari.
Gažaldat guoská mannan jahkái.
Merkes dohko gokko heive buoremusat.

Logat, geahčat TV dahje leat eará čohkkán-hommáin? ..... 25 — 1

Váccašat, syhkkelastat, dahje lihkadalat eará láhkái unnimusat 4 tiimma vahkus? 2
(Dás galggat váldit mielde jos váccát dahje syhkkelastat bargui, sotnabeaituvrraid j.ea.)

Lášmmohalat, divššut bealddu dálut olggobealde d.s.?? 3
(Fuopmá ahte doaibma galgá bistit unnimusat 4 tiimma vahkus.)

Hárjehalat garrasit dahje leat mielde gilvvohallamiiguin dávjá ja máŋgga geardde vahkus? — 4

E SÁLTI/VUODJA

Man dávjá lea dus sáltebiergu dahje sálteguolli málisin?
Merkes dohko gokko heive buoremusat

Ii goassege dahje hárvvit go oktii mánus ..... 26 — 1
Oktii vahkus 2
Guktii vahkus 3
Eambbo go guktii vahkus 4

Man dávjá botkkuhat sálttiid mállásii?
Merkes dohko gokko heive buoremusat.

Hárve dahje in goassege ..... 27 — 1
Muhtimin dahje dávjá 2
Álo dahje measta álo 3

Makkár vuoja geavahat láibevajahasas?
Merkes dohko gokko heive buoremusat.

In geavat vuoja láibevajahasas ..... 28 — 1
Vuoja 2
Garra márgáriinna 3
Litna márgáriinna 4
Vuodja/márgáriidna seaguhusa 5

Makkár vuoja geavahat dábálaččat go borramušaid ráhkadat?
Merkes dohko gokko heive buoremusat

Vuoja dahje garra márgáriinna ..... 29 — 1
Litna márgáriinna dahje olju — 2
Vuodja/márgáriidna seaguhusa — 3

F BORGGUHEAPMI

Juo | In

Borgguhat go dál beaivválaččat 30

Jos vástádus lea «juo», de vástit dalle:
Borgguhat go sigareahtaid beaivválaččat? 31
(iešgissojuvvon dahje fábrihkkagissojuvvon)

Jos it borggut sigareahtaid dál, de vástit:
Leat go ovdal borgguhan sigareahtaid beaivválaččat 32

Jos vástádus lea «juo», de vástit goas leat heaitán?
Unnit go 3 mánu áigi? ..... 33 — 1
3 mánu – jagi áigi — 2
1–5 jagi áigi? — 3
Eambbo go 5 jagi áigi? — 4

Sii geat borgguhit dál dahje leat ovdal borgguhan vástidit:
Galle jagi leat borgguhan beaivválaččat oktiibuot ..... 34 — jagi

Galle sigareahta borgguhat dahje borgguhit beaivválaččat?
Čále beaivválaš sigareahttalogu ..... 36 — sigareahta
(iešgissojuvvon + fábrihkkagissojuvvon)

Borgguhat go eará earret sigareahtaid beaivválaččat?
Sigaraid dahje seruhtaid/sigarillosaid? 40
Biippu? 41

Jos borgguhat biippu, de vástit galle duhpátpáhka (50 gramma) mannet biippostallamii vahkus?
Čále gaskamearálas páhkkalogu vahkus ..... 42 — duhpátpáhka

G KÁFFE

Galle gohpu káfe jugat beaivvis?

In juga káfe, dahje unnit go ovtta gohpu ..... 45 — 1
1–4 gohpu — 2
5–8 gohpu — 3
9 gohpu dahje eanet — 4

Makkár káfe jugat beaivválaččat?
Vuoššankáfe 46
Filterkáfe 47
Pulvarkáfe 48
Koffeinkeahtes káfe 49
In juga káfe 50

H BARGU

Juo | In/Ii

Leat go maŋimus 12 mánu ožžon bargguhisvuođa-ruđaid? 51

Leat go dál diеđihuvvon buohccin dahje oaččut go máhcahan-rudaid? 52

Oaččut go ollásit dahje oasi lámisvuođa-ruđain 53

Lea go dus lotnolasbargu dahje idjabargu 54

Lea go dus leamaš mannan jagis:
Merkes dohko gokko heive buoremusat.
Eanaš áiggi čohkkán bargu? ..... 55 — 1
(omd. čállinbargu, tiibmadivodanbargu, monteren)
Bargu mii gáibida ahte váccát ollu? 2
(omd. buvdabargu, geahpa industriabargu, oahpahanbargu)
Bargu mii gáibida ollu vázzima ja lovttohallama? — 3
(omd. poastavázzi, lossa industriabargu, huksenbargu)
Lossa rumašlašbargu? 4
(omd. vuovdebargu, lossa eanadoallobargu, lossa huksenbargu)

Juo | Ii

Lea go dálueamitbargu du oaivedoaibma? 56

I MAŋŋIL-GEAHČADEAPMI

Lea go earát du ruovttus (earret ieš) gohčohallan doaktára lusa maŋimus váibmovihkigeahčadeami maŋŋil 57

Juo | Ii | In diede

Lea go guovtis dahje eambu vánheimiidvánhemiin suomasogalažžat? 58
Lea go guovtis dahje eambu vánheimiidvánhemiin sámesogalažžat? 59

Jos dát dearvvasvuođaguorahallan čájeha dárbbu gohččut du boahtit geahčadeapmái:
Lea go dus erenoamáš doavttir gean lusa háliidat?

Čále su nama dása

Ale čále dákko

..... 60

Ii leat erenoamáš doavttir .....

63

Ale čále dákko

Appendix B

Questionnaire SAMINOR 1, 2003-04

Helse- og levekårs-undersøkelsen

Personlig innbydelse

1. EGEN HELSE

Hvordan er helsen din nå? *(Sett bare ett kryss)*

☐ Dårlig [1] ☐ Ikke helt god [2] ☐ God [3] ☐ Svært god [4]

Har du, eller har du hatt?

	JA	NEI	Alder første gang
Astma	☐	☐	
Kronisk bronkitt/emfysem/KOLS	☐	☐	
Diabetes (sukkersyke)	☐	☐	
Fibromyalgi/kronisk smertesyndrom	☐	☐	
Psykiske plager som du har søkt hjelp for	☐	☐	
Hjerteinfarkt (sår på hjertet)	☐	☐	
Angina pectoris (hjertekrampe)	☐	☐	
Hjerneslag/hjerneblødning	☐	☐	
Multippel sklerose (MS)	☐	☐	
Ulcerøs kolitt	☐	☐	

Får du smerter eller ubehag i brystet når du:	JA	NEI
Går i bakker, trapper eller fort på flatmark?	☐	☐
Kan slike smerter opptre selv om du er i ro?	☐	☐

2. MUSKEL OG SKJELETTPLAGER

	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?	☐	☐

Har du noen gang hatt:	JA	NEI	Alder siste gang
Brudd i håndledd/underarm?	☐	☐	
Lårhalsbrudd?	☐	☐	

3. MAGE OG TARM SYMPTOMER

	JA	NEI
Har du hatt sure oppstøt, halsbrann eller brystbrann nesten daglig i minst en uke?	☐	☐
Har du noen gang hatt smerter eller verk i magen som har vart i minst 2 uker?	☐	☐

Hvis JA, hvor i magen sitter smertene? *(Sett ett kryss)*

☐ Øvre del ☐ Nedre del ☐ Hele magen

Er smertene eller «verken» jevnt over tilstede? *(Sett ett kryss)*

I perioder av ukers varighet ☐

I perioder av måneders varighet ☐

Bestandig ☐

	JA	NEI
Er du ofte plaget av oppblåsthet, rumling i magen eller rikelig luftavgang?	☐	☐

3. MAGE OG TARM SYMPTOMER (fortsettelse)

Er avføringen din vanligvis: *(Sett ett eller flere kryss)*

☐ Normal ☐ Løs ☐ Hard og perlete

☐ Vekslende hard og løs ☐ Illeluktende

	JA	NEI
Har du i perioder tre eller flere avføringer daglig?	☐	☐
Har du hatt plager i mage/tarm etter inntak av melk?	☐	☐

Er det andre i familien som har de samme magesymptomene?

☐ Mor ☐ Far ☐ Søsken ☐ Barn ☐ Ingen

4. ANDRE PLAGER

Under finner du en liste over ulike problemer. Har du opplevd noe av dette *den siste uken* (til og med i dag)?

(Sett ett kryss for hver plage)

	Ikke plaget [1]	Litt plaget [2]	Ganske mye [3]	Veldig mye [4]
Plutselig frykt uten grunn	☐	☐	☐	☐
Føler deg redd eller engstelig	☐	☐	☐	☐
Matthet eller svimmelhet	☐	☐	☐	☐
Føler deg anspent eller oppjaget	☐	☐	☐	☐
Lett for å klandre deg selv	☐	☐	☐	☐
Søvnproblemer	☐	☐	☐	☐
Nedtrykt, tungsindig	☐	☐	☐	☐
Følelse av å være unyttig, lite verd	☐	☐	☐	☐
Følelse av at alt er et slit	☐	☐	☐	☐
Følelse av håpløshet mht. framtida	☐	☐	☐	☐
Tenkt på å gjøre slutt på livet ditt	☐	☐	☐	☐

5. SYKDOM I FAMILIEN

	JA	NEI	VET IKKE
Har en eller flere av dine foreldre eller søsken hatt hjerteinfarkt eller angina pectoris?	☐	☐	☐

Kryss av for de slektningene som har eller har hatt noen av sykdommene og angi deres alder for når de fikk sykdommene. *(Hvis flere søsken, før opp den som fikk det tidligst i livet)*

	Mor	Far	Søster	Bror	Barn	Ingen	Alder første gang
Hjerteinfarkt før 60-års alder	☐	☐	☐	☐	☐	☐	
Hjerteinfarkt etter 60 års-alder	☐	☐	☐	☐		☐	
Diabetes	☐	☐	☐	☐	☐	☐	
Hjerneslag	☐	☐	☐	☐	☐	☐	
Astma	☐	☐	☐	☐	☐	☐	
Tykktarmskreft	☐	☐	☐	☐	☐	☐	
Brystkreft	☐	☐	☐	☐	☐	☐	
Eggstokkreft	☐		☐		☐	☐	

Hvor mange søsken har du? ___ Brødre ___ Søstre

6. BRUK AV MEDISINER

Med medisiner mener vi her medisiner kjøpt på apotek. Kosttilskudd og vitaminer regnes ikke med her.

Bruker du?	Nå	Før, men ikke nå	Aldri brukt
Medisin mot høyt blodtrykk ...	☐	☐	☐
Kolesterolsenkende medisin ...	☐	☐	☐
Insulin	☐	☐	☐
Tabletter mot sukkersyke	☐	☐	☐

Hvor ofte har du i løpet av *de siste 4 ukene* brukt følgende medisiner? *(Sett ett kryss pr. linje)*

	Ikke brukt siste 4 uker	Sjeldnere enn hver uke	Hver uke, men ikke daglig	Daglig
Smertestillende uten resept	☐	☐	☐	☐
Smertestillende på resept	☐	☐	☐	☐
Sovemedisin	☐	☐	☐	☐
Beroligende medikamenter	☐	☐	☐	☐
Medisiner mot depresjon	☐	☐	☐	☐
Annen medisin på resept	☐	☐	☐	☐
	1	2	3	4

For de medisinene du har krysset av for i de to punktene ovenfor og som du har brukt i løpet av *de siste 4 ukene*:

Angi navnet og hvilken grunn det er til at du tar/har tatt disse (sykdom eller symptom):*(Kryss av for hvor lenge du har brukt medisinen)*

Navn på medisinen: *(sett ett navn pr. linje)*	Grunn til bruk av medisinen:	Hvor lenge? Inntil 1 år	1 år eller mer
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐

Dersom det ikke er nok plass her, kan du fortsette på eget ark som du legger ved.

7. MAT OG DRIKKE

Hvor ofte spiser du vanligvis disse matvarene?
(Sett ett kryss pr. linje)

	Sjelden/ aldri	1-3 g. pr.mnd	1-3 g. pr. uke	4-6 g. pr. uke	1-2 g. pr. dag	3 g. el. mer pr. dag
Frukt	☐	☐	☐	☐	☐	☐
Bær	☐	☐	☐	☐	☐	☐
Ost *(alle typer)*	☐	☐	☐	☐	☐	☐
Poteter	☐	☐	☐	☐	☐	☐
Kokte grønnsaker	☐	☐	☐	☐	☐	☐
Rå grønnsaker/salat	☐	☐	☐	☐	☐	☐
	1	2	3	4	5	6

7. MAT OG DRIKKE (fortsettelse)

Hva slags fett bruker du oftest? *(Sett ett kryss pr. linje)*

	Bruker ikke	Meieri-smør	Hard margarin	Myk/lett margarin	Oljer	Annet
På brødet	☐	☐	☐	☐	☐	☐
I matlagingen	☐	☐	☐	☐	☐	☐
	1	2	3	4	5	6

Bruker du følgende kosttilskudd:

	Ja, daglig	Iblant	Nei
Tran, trankapsler?	☐	☐	☐
Fiskeoljekapsler *(omega 3)?*	☐	☐	☐
Vitamin- og/eller mineraltilskudd?	☐	☐	☐

Hvor mye drikker du vanligvis av følgende? *(Sett ett kryss pr. linje)*

	Sjelden/ aldri	1-6 glass pr. uke	1 glass pr. dag	2-3 glass pr. dag	4 glass el. mer pr. dag
Helmelk, kefir, yoghurt ..	☐	☐	☐	☐	☐
Lettmelk, cultura, lett yoghurt	☐	☐	☐	☐	☐
Skummet melk (sur, søt)	☐	☐	☐	☐	☐
Ekstra lettmelk	☐	☐	☐	☐	☐
Fruktjuice	☐	☐	☐	☐	☐
Vann	☐	☐	☐	☐	☐
Brus/Cola med sukker ...	☐	☐	☐	☐	☐
Brus/Cola uten sukker ...	☐	☐	☐	☐	☐
	1	2	3	4	5

Hvor mange kopper kaffe og te drikker du *daglig?*
(Sett 0 for de typene du ikke drikker daglig) Antall kopper

Filterkaffe .... ☐☐

Kokekaffe/trykkanne............................ ☐☐

Annen kaffe .... ☐☐

Te .... ☐☐

Omtrent hvor ofte har du i løpet av det siste året drukket alkohol? *(Lettøl og alkoholfritt øl regnes ikke med)*

Har aldri drukket alkohol ☐ 1	Har ikke drukket siste år ☐ 2	Noen få ganger siste år ☐ 3	Omtrent 1 gang i måneden ☐ 4
2-3 ganger pr. måned ☐ 5	Ca. 1 gang i uka ☐ 6	2-3 ganger i uka ☐ 7	4-7 ganger i uka ☐ 8

Til dem som har drukket siste år:
Når du har drukket, hvor mange glass eller drinker har du vanligvis drukket? Antall ☐☐

Omtrent hvor mange ganger det siste året har du drukket så mye som minst 5 glass eller drinker i løpet av ett døgn? Antall ganger ☐☐

Når du drikker, drikker du da vanligvis: *(Sett ett eller flere kryss)*
☐ Øl ☐ Vin ☐ Brennevin

8. RØYKING OG BRUK AV SNUS

Hvor lenge er du vanligvis daglig i et røykfylt rom? Antall hele timer ☐☐

Røykte noen av de voksne hjemme da du vokste opp? JA ☐ NEI ☐

Bor du, eller har du bodd, sammen med noen dagligrøykere etter at du fylte 20 år? JA ☐ NEI ☐

Har du røykt/røyker du daglig? Ja, nå ☐ Ja, før ☐ Aldri ☐

Hvis du røyker daglig nå, røyker du:

	JA	NEI
Sigaretter?	☐	☐
Sigarer/sigarillos/pipe?	☐	☐
Rulletobakk/rullings?	☐	☐

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/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 ☐☐

Har du brukt/bruker du snus daglig? Ja, nå ☐ Ja, før ☐ Aldri ☐

Hvis du bruker/har brukt snus, hvor mange år til sammen har du brukt snus? Antall år ☐☐

9. MOSJON OG FYSISK AKTIVITET

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

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 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
(Regn også 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

10. UTDANNING OG ARBEID

Hvor mange års skolegang har du gjennomført? *(Ta med alle år du har gått på skole eller studert)* Antall år ☐☐

Hvordan trives du i din jobb?

1 ☐ Svært godt 2 ☐ Godt 3 ☐ Dårlig 4 ☐ Veldig dårlig

Mener du at du står i fare for å miste ditt nåværende arbeid eller inntekt de nærmeste 2 årene? JA ☐ NEI ☐

Mottar du noen av følgende ytelser?

	JA	NEI
Sykepenger	☐	☐
Attføring	☐	☐
Sosialhjelp/-stønad	☐	☐
Overgangsstønad for enslige forsørgere	☐	☐

11. RESTEN AV SKJEMAET SKAL BARE BESVARES AV KVINNER

Hvor gammel var du da du fikk menstruasjon aller første gang? Alder i år ☐☐

Hvis du ikke lenger får menstruasjon, hvor gammel var du da den sluttet? Alder i år ☐☐

Er du gravid nå?

Ja ☐ 1 Nei ☐ 2 Usikker ☐ 3 Over fruktbar alder ☐ 4

Hvor mange barn har du født? Antall barn ☐☐

Hvis du har født barn, fyll ut hvert barns fødselsår, og hvor mange måneder du ammet etter fødselen.
(Hvis du ikke ammet, skriv 0)

Barn:	Fødselsår:	Ammet antall mnd.:
1. barn	☐☐☐☐	☐☐
2. barn	☐☐☐☐	☐☐
3. barn	☐☐☐☐	☐☐
4. barn	☐☐☐☐	☐☐
5. barn	☐☐☐☐	☐☐

(Hvis flere barn, bruk ekstra ark)

Bruker du, eller har du brukt? *(Sett ett kryss for hver linje)*

	Nå	Før, men ikke nå	Aldri
P-pille/minipille/p-sprøyte	☐	☐	☐
Hormonspiral (ikke vanlig spiral)	☐	☐	☐
Østrogen (tabletter eller plaster)	☐	☐	☐
Østrogen (krem eller stikkpiller)	☐	☐	☐

Hvis du bruker/har brukt *reseptpliktig* østrogen:
Hvor lenge har du brukt dette? Antall år ☐☐

Hvis du bruker p-pille, minipille, p-sprøyte, hormonspiral eller østrogen; hvilket merke bruker du?

Spesifiser:

Ikke skriv her ☐☐ ☐☐

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SKADER/ULYKKER (fortsettelse)

Hvis ja, hva slags ulykke(r) er du blitt behandlet for? *(sett ett eller flere kryss pr. linje)*

	Arbeid	Hjem	Fritid	Ingen
Bil	☐	☐	☐	☐
Motorsykkel	☐	☐	☐	☐
Snøscooter	☐	☐	☐	☐
Firehjulssykkel	☐	☐	☐	☐
Traktor	☐	☐	☐	☐
Fallulykke	☐	☐	☐	☐
Kuttskade	☐	☐	☐	☐
Annet	☐	☐	☐	☐

Har ulykken(e) ført til nedsatt arbeidsevne?

☐ Helt ☐ Delvis ☐ Ikke i det hele tatt

FAMILIE OG SPRÅKBAKGRUNN

I Nord-Norge bor det folk med ulik etnisk bakgrunn. Det vil si at de snakker ulike språk og har forskjellige kulturer. Eksempler på etnisk bakgrunn, eller etnisk gruppe er norsk, samisk og kvensk.

Hvilket hjemmespråk har/hadde du, dine foreldre og besteforeldre? *(sett ett eller flere kryss)*

	Norsk	Samisk	Kvensk	Annet, beskriv
Morfar:	☐	☐	☐	☐ ....
Mormor:	☐	☐	☐	☐ ....
Farfar:	☐	☐	☐	☐ ....
Farmor:	☐	☐	☐	☐ ....
Far:	☐	☐	☐	☐ ....
Mor:	☐	☐	☐	☐ ....
Jeg selv:	☐	☐	☐	☐ ....

Hva er din, din fars og din mors etniske bakgrunn? *(sett ett eller flere kryss)*

	Norsk	Samisk	Kvensk	Annet, beskriv
Min etniske bakgrunn er:	☐	☐	☐	☐ ....
Fars etniske bakgrunn er:	☐	☐	☐	☐ ....
Mors etniske bakgrunn er:	☐	☐	☐	☐ ....

Hva regner du deg selv som? *(sett ett eller flere kryss)*

Norsk	Samisk	Kvensk	Annet, beskriv
☐	☐	☐	☐ ....

ARBEIDSLIV/ØKONOMI

Hvilken type arbeid/livsopphold har du? *(sett ett eller flere kryss)*

☐ Fastlønnet, heltid ☐ Fastlønnet, deltid
☐ Sesongarbeid ☐ Selvstendig næringsdrivende
☐ Arbeidsledig ☐ Hjemmeværende
☐ Alderstrygd ☐ Uføretrygd
☐ Annet *(beskriv)* ....

ARBEIDSLIV/ØKONOMI (fortsettelse)

Kunne du tenke deg å flytte fra din bostedskommune dersom du fikk tilbud om arbeid et annet sted?

☐ Ja ☐ Nei ☐ Deler av året ☐ Usikker

Dersom du er *arbeidsledig*, angi hvor lenge du har vært arbeidssøker: *(angi i hele tall)*

☐☐ *(år)* ☐☐ *(måneder)*

Dersom du er *selvstendig næringsdrivende*, hvilken type næring jobber du i? *(sett ett eller flere kryss)*

☐ Reindrift ☐ Fiske ☐ Jordbruk ☐ Skogbruk
☐ Forretningsvirksomhet ☐ Annet *(spesifiser)* ....

Hvor mange personer bor det i din husstand?

☐☐ *(antall personer)*

Hvor stor er familiens/husstandens bruttoinntekt per år?

☐ Under kr. 150 000 ☐ Kr. 150 000–300 000
☐ Kr. 301 000–450 000 ☐ Kr. 451 000–600 000
☐ Kr. 601 000–750 000 ☐ Over kr. 750 000

Hvor ofte spiller du på ulike pengespill slik som lotto, tipping, spilleautomater og lignende?

☐ Aldri/sjelden ☐ 1-3 ganger i mnd.
☐ 1 gang i uka ☐ 2-6 ganger i uka ☐ Hver dag

Hvor mye spiller du for ukentlig i gjennomsnitt?

☐ Under kr. 100 i uka ☐ Kr. 100-500 i uka
☐ Kr. 501–1000 i uka ☐ Over kr. 1000 i uka

MOBBING

Med mobbing mener vi når en eller flere personer *gjentatte ganger* sier eller gjør vonde ting mot deg, og du har vanskeligheter med å forsvare deg.

Har du vært utsatt for mobbing?

☐ Ja, de siste 12 mnd. ☐ Ja, før ☐ Nei

Dersom du har vært utsatt for mobbing, hvilken type mobbing er du blitt utsatt for? *(sett ett eller flere kryss)*

☐ Baksnakking ☐ Ignorering
☐ Diskriminerende bemerkninger ☐ Annet

Kan du angi hvor dette foregår/foregikk? *(sett ett eller flere kryss)*

☐ På skolen ☐ På skoleinternat ☐ I yrkeslivet
☐ I lokalsamfunnet ☐ Annet

Appendix C

Interview guide (Paper I)

INTERVJUGUIDE

Reg. nr: **Dato**..........

Alder (antall år):.......... **Kjønn:** ♂ ♀

Yrke: **Arbeidstid:**

Trygdet: **Ja** **Nei**

SPØRRESKJEMA I D

1. Hva forstår du med fritid?

2. Hva forstår du med arbeid? (stillesittende/tungt kroppsarbeid)

3. Hva forstår du med bevegelse og kroppslig aktivitet i din fritid?

4. Hva er fysisk aktivitet? (lett/tung)

5. Er bærplukking, jakt og fiske fritidsaktivitet eller jobb?

6. Hva forstår du med mosjonsidrett?

7. Hva forstår du med konkurranseidrett?

SPØRRESKJEMA I H

8. Hvordan vil du klassifisere jordbruk og reindrift i henhold til skalaen fra 1-4?
9. Hvordan vil du klassifisere husmorarbeid i forhold til skalaen?

SPØRRESKJEMA II

10. Hva forstår du med endret fysisk aktivitet?