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Increasing physical activity, but persisting social gaps among middle-aged people: trends in Northern Sweden from 1990 to 2007

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Background: Physical activity is identified as one important protective factor for chronic diseases. Physical activity surveillance is important in assessing healthy population behaviour over time. Many countries lack population trends on physical activity.

Objective: To present trends in physical activity levels in Västerbotten County, Sweden and to evaluate physical activity among women and men with various educational levels.

Methods: Population-based cross-sectional and panel data from the Västerbotten Intervention Programme (VIP) during 1990–2007 were used. All individuals in Västerbotten County who turned 40, 50, or 60 years old were invited to their local primary health care for a health screening. Physical activity during commuting, recreational activities, physical exercise, and socio-demographic data were collected using a self-administered questionnaire. Respondents were categorised as sedentary, moderate physically active, or physically active.

Results: The prevalences of physically active behaviours increased from 16 to 24.2% among men and from 12.6 to 30.4% among women. Increases are observed in all educational groups, but gaps between educational groups widened recently. The level of sedentary behaviour was stable over the time period studied. The 10-year follow-up data show that the prevalences of physically active behaviours increased from 15.8 to 21.4% among men and 12.7 to 23.3% among women. However, 10.2% of men and 3.8% of women remained sedentary.

Conclusion: Despite the promising evidence of increasing physical activity levels among the population in Västerbotten County, challenges remain for how to reduce the stable levels of sedentary behaviours in some subgroups. Persisting social gaps in physical activity levels should be addressed further. An exploration of people's views on engaging in physical activity and barriers to doing so will allow better formulation of targeted interventions within this population.

Keywords: *physical activity*; *sedentary lifestyle*; *health promotion*; *educational status*; *longitudinal studies*; *Sweden*

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Physical activity is increasingly promoted globally as a healthy lifestyle behaviour (1, 2). The World Health Organisation (WHO) emphasises the need and importance of regular physical activity across all age spans (1). Regular physical activity improves cardiorespiratory fitness, enhances cognitive function, lowers overall premature mortality, and decreases the risk of cardiovascular diseases, some cancers, musculoskeletal diseases, neurodegenerative diseases, and depression (1–3). The WHO recommends that "Adults aged 18–64 should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity." Additional health benefits can be obtained if adults do

twice as much as recommended (1). In 2008, the US government also used the same level of recommendation to promote regular physical activity among the US population (2). Increasing levels of sedentary behaviour, particularly among youth and people living in urban areas, have become a growing public health concern in many high income countries in Europe and the United States (4, 5).

Physical activity surveillance is important in assessing population health over time. However, surveillance activities and repeated cross-sectional studies of physical activity using a standardised and consistent instrument over time and across countries are lacking, even in European countries (6, 7). The Eurobarometer survey collects information on different issues including health among members of the European Union (EU). The special Eurobarometer 246, conducted in 27 EU countries in 2005, showed that 51% of EU citizens reported very little vigorous physical activity at work. The proportions who reported a lot of physical activity at work ranged from 10% in Malta and Italy to 27% in Poland, the Netherlands, and Lithuania (8). The WHO MONICA study, a multinational study to monitor the trends and determinants in cardiovascular diseases assessed physical activity as an optional section of its questionnaire. Therefore, trend data are not available for many of the 21 WHO MONICA participating countries (9). In addition, many countries only have cross-sectional data available.

The aim of this study is to describe trends in physical activity levels using population based, cross-sectional, and longitudinal panel data with a particular focus on differences in physical activity levels among men and women across educational groups in Sweden.

Methods

Study setting and participants

The Västerbotten Intervention Programme (VIP) was initiated in 1985 in Västerbotten County, located in Northern Sweden. Västerbotten County is one of the counties with the lowest population density in Sweden. There are only 4.7 inhabitants per km^2 compared to Swedish national average of 22.8 inhabitants per km^2. Although Västerbotten County covers approximately one-eighth of Sweden's total land area, it has only 2.8% of the population. Approximately 50% of the Västerbotten population lives in the largest city and its surrounding municipalities. Approximately 30% of the total population lives in small towns and about 20% lives in villages and sparsely populated rural areas. Approximately 19% of the Västerbotten population is over 65 years old and the life expectancy is 78.9 years for men and 83.2 years for women (10). Located between 61° and 64° north of the equator, the people in Västerbotten County experience long dark winters with snow and this influences how people commute and spend their leisure time during winter months.

The VIP was continuously improved during the first 5 years and underwent implementation in the entire county in 1990. Each year, all individuals who turn 30, 40, 50, or 60 years old are invited to their local primary health care centre for a health survey and examination. This study is limited to participants who provided data during the survey years of 1990–2007; that is, 18 cross-sectional surveys. In the cross-sectional analysis, participants aged 30 years were excluded since they were not invited after 1995. The 104,147 individuals who participated in VIP during 1990–2007 represented 60% of the total population aged 40, 50, and 60 who were registered in Västerbotten County during the same period. The annual survey participation rates varied from 53 to 67%. A total of 102,205 individuals with complete information (98% of all participating individuals) on physical activity and educational level were included in this study. Approximately 34, 36, and 30% of the respondents were 40, 50, and 60 years old at baseline. About half of the VIP respondents had a medium educational level (48%), while 26% had basic education. The percentage of individuals with basic education decreased from 37% during 1990–1995 to 18% during 2002–2007. Levels of education were higher and increased more among women (35% of women had high education in 2002–2007 as compared to 25% of men).

A total of 26,382 individuals aged 30, 40, or 50 at baseline (1990–1997) also participated in a 10-year follow-up survey when they turned 40, 50, or 60 during 2000–2007 (11). The overall annual participation rate in a 10-year follow-up survey was 63%–72% during 2000–2005 and has been 75%–79% thereafter. After exclusion of participants who were not followed-up due to death, migration out of the region, or other reasons, the participation rate in the follow-up survey during 2000–2007 was 76%. Comparison of the baseline socio-demographic indicators between those who participated in the follow-up survey and those who did not showed small differences in age and education levels between the participants and non-participants. There were slightly more people aged 30 and those with high education who did not participate in the follow-up surveys.

Measurements

The VIP participants completed a health questionnaire that included socio-demographic and psychosocial conditions, self-reported health, self-reported quality of life, social support, working condition, history of chronic disease, and assessment of chronic disease risk factors such as tobacco use, physical activity, and measured body mass index. A blood sample was drawn after an overnight fast. Results of the questionnaire and blood examination

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were provided to the participants at the time of the survey. Detailed descriptions of the background, design, and methods of VIP are described elsewhere (11, 12). In this study, we used the information on physical activity and educational levels.

The highest completed level of education was used to assess participant educational level. Participants who completed only elementary and the comprehensive compulsory 9-year school were categorised as having basic education. Graduates from a residential college for adult education or high school were categorised as having medium education. Graduates from college or higher level of education were categorised as having high education.

The questionnaire section on physical activity assesses physical activities on commuting, recreational time, and physical exercise. The following questions are asked:

> How do you usually travel to and from work each of the four seasons? And what is the distance to your work?
> How often do you participate in recreational activities that require some physical effort? Two activities were asked about, i.e. walking and bicycling.
> How often have you worked out or exercised in your training clothes during the last 3 months with the purpose of improving your physical condition and/or your well-being?

We only assessed mode of travel to work during winter, because we think that people who walk or use their bicycle to travel to work during the snowy and icy winter will also probably do that the rest of the year. The information about distance to work was used only if the respondent walked or cycled to their work. Responses from these three questions were combined and used to categorise the respondents as sedentary, moderately active, or physically active (Table 1).

Statistical analyses

The age-adjusted prevalences of physical activity levels were analysed for each sex and educational level. The population trends in physical activity level were presented using the 18 years of cross-sectional data. Simple linear regression analysis using the prevalence of physical activity level (dependent variable) over the year (independent variable) was done to estimate the annual change in the prevalence. The regression coefficient represents the change in prevalence over one year. As the survey invites people aged 40, 50, and 60 years every year, no age adjustment was conducted in comparing the physical activity levels across time. Physical activity levels at baseline and 10-year follow-up for men and women in each educational group were compared using the panel data. As the sample size was large, a p-value of <0.01 was required for statistical significance. Data analyses were performed using STATA Version 11 (STATA Corporation, Texas).

Ethical consideration

The regional Research Ethics Board in Umeå approved this study. Individuals provided consent prior to each health survey.

Table 1. Definitions of physical activity levels

	Questions on physical activity				
Levels of physical activities	Mode of travel to and from work (Q1)		Recreational activity (Q2)		Physical exercise (Q3)
Sedentary	By bus or car during winter OR cycled or walked less than 2 km each way during winter	OR	Walked or cycled less than 3–4 times per month	OR	Never exercised during the last 3 months
Moderately active	Cycled or walked at 2–5 km each way during winter	OR	Walked or cycled at least 2 times per week	OR	Exercised, but not regularly, during the last 3 months
Physically active	Cycled or walked at least 5 km each way during winter	OR	Walked or cycled every day	OR	Exercised at least 2–3 times per week during the last 3 months

Note: The following three questions were used in the questionnaire:
(Q1). 'How do you usually travel to and from work each of the four seasons? And what is the distance to your work?'
(Q2). 'How often do you participate in recreational activities that require some physical effort?' Two activities were asked about, i.e. walking and bicycling.
(Q3). 'How often have you worked out or exercised in your training clothes during the last 3 months with the purpose of improving your physical condition and/or your well-being?'
We assumed that people who commute by walking or biking during winter with its cold, ice, and snow also do that the rest of the year.

Results

Trends of physical activity in cross-sectional data

In general, the population became more physically active during the study period. Prevalences of physically active behaviour increased from 16 to 24.2% in men and 12.6 to 30.4% in women between 1990 and 2007. Fig. 1 presents detailed descriptions of the observed annual trends across educational groups. The proportion of physically active people increased in all educational groups, although this was most obvious among the high educational group, especially after 1999.

During 1990–2007, the prevalences of physically active behaviour were consistently higher in men and women with high education compared to those with basic education (Table 2). During 2002–2007, only 16.6% of men and 18.7% of women with basic education were physically active, as compared to 32.6% of men and 32% of women with high education. Increases in the prevalence of physically active behaviour were observed in all educational groups and more marked among women and those with high education. The gaps between educational groups have consequently widened in recent years. The prevalence increased from 12.9 to 32% among women with high education as compared to 11.7 to 18.7% among women with basic education. During the same period, the prevalence of physically active behaviour increased by 123 and 148% in women with medium and high education, respectively. The increases in the prevalence of physically active behaviour were observed in parallel with a decreased prevalence of moderate activity and a stable prevalence of sedentary behaviour (Table 2).

Sedentary behaviour was more prevalent among men in all educational groups compared to women, but this was most marked among those with basic education. During 1990–2007, the gender gap in prevalence of sedentary behaviour was four percentage points in the highly educated group compared to 12 percentage points among those with basic education (Table 2). During the 18 years of observation, prevalence of sedentary behaviour was stable and the small decreases among people with medium and high education were not statistically significant. There was an increase in sedentary behaviour among men with basic and medium educations, though the prevalence was statistically significant only among men with basic education (Table 2).

Changes in physical activity behaviour between baseline and follow-up

Fig. 2 shows changes in physical activity patterns between baseline and 10-year follow-up. The proportions of those physically active increased from 16 to 21% among men and 13 to 23% among women. The proportion of sedentary behaviour changed marginally from 23 to 21% in men and 13 to 11% in women. Prevalences of sedentary behaviour decreased in all age cohorts and educational groups except among the 30-year cohort of men with medium and high education. An increase in the prevalence of sedentary behaviour was observed in this group (Fig. 3). Similar to the cross-sectional data and irrespective of the reduction of sedentary behaviours, the panel data reveal that sedentary behaviours were more prevalent in all age groups among men with lower educational level compared to higher. The differences between educational groups were small among women in all ages as shown in Fig. 3.

When the participants were grouped by physical activity patterns at baseline and follow-up, 10.2% of men and 3.8% of women remained sedentary after 10 years. Change in activity from moderately active to sedentary over 10 years was 10.1% among men and 6.4% among women. The 10-year change from moderately active to physically active was most pronounced among women (11.5% in men vs. 15.9% in women) (Table 3).

Discussions

Growing proportion of physically active behaviour and stagnant level of sedentary behaviour

During the 18-year study period, the population of Västerbotten County became more physically active. Our findings align with the Swedish national patterns of physical activity. There has been a trend of increased physical activity among Swedish adults during the last two decades (13). In the 1980s, 47% of men and 43% of women aged 16–74 years reported being physically active on a regular basis during leisure time. These proportion increased to 58% among men and 60% among women in 2002 (14). Another important finding is the overall persistent level of prevalence of sedentary behaviours, particularly among men and those with basic education. While people who were moderately active become more active, the sedentary group remained sedentary. At the national level, physically inactive behaviours decreased slowly from 14% among men and women in the 1980s to 12% among men and 10% among women in 2002 (14). The sex difference in prevalence of sedentary behaviour was much larger in our study compared to the 2002 national report.

Widening social gaps in physical activity over time

There was a gradient of physical activity levels across educational groups and the gaps widened during the 18-year study. People with high education were more physically active and became more active than those with basic education. The widening gap was mainly due to a stable level of sedentary behaviour and sedentary behaviour increased among men with basic education. These data confirm the 2006 Swedish National Health Institute report that showed socio-demographic differences in physical

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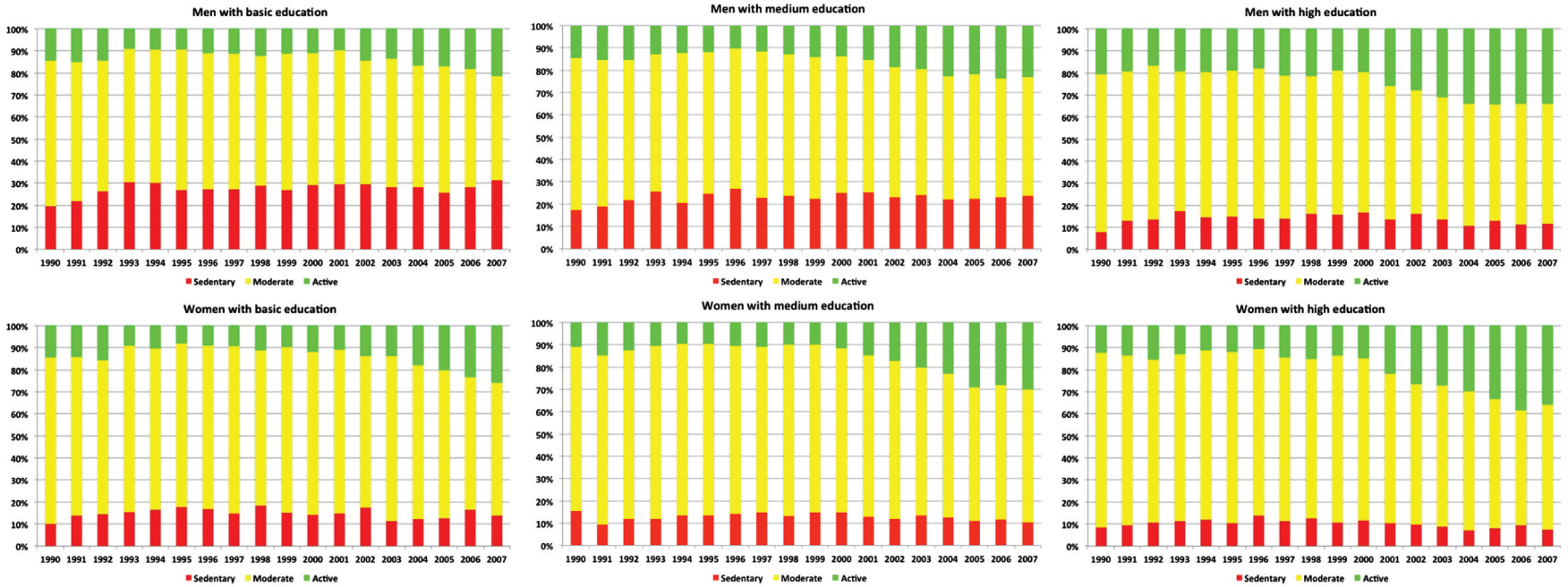

Fig. 1. Physical activity level trends in Northern Sweden from 1990 to 2007 among men and women and by educational levels. Cross-sectional data from the Västerbotten Intervention Programme.

Table 2. Prevalence of physical activity levels among men and women by year and education, adjusted for age

	Levels of education					
	Basic education		Medium education		High education	
Time period	Men	Women	Men	Women	Men	Women
Sedentary (%)						
1990–1995	26.4	14.9	22.2	12.6	13.8	10.5
1996–2001	28.1	15.7	24.4	14.1	14.9	11.6
2002–2007	28.4	13.9	23.1	11.8	12.6	8.4
1990–2007	27.3	15.2	23.4	12.7	13.7	9.8
Annual percentage changes (*p*-value)	0.30	−0.02	0.16	−0.08	−0.03	−0.15
	($p=0.02$)	($p=0.85$)	($p=0.14$)	($p=0.34$)	($p=0.78$)	($p=0.06$)
Cumulative percentage changes, 1990–2007 (%)	7.6	−6.7	4.1	−6.3	−8.7	−20.0
Moderate activity (%)						
1990–1995	62.0	73.2	64.4	76.4	67.5	76.7
1996–2001	60.8	73.7	62.7	74.7	64.2	73.2
2002–2007	55.1	67.3	55.2	63.2	54.7	59.4
1990–2007	59.9	72.3	59.8	70.3	60.8	67.7
Annual percentage changes (*p*-value)	−0.64	−0.56	−0.79	−1.03	−1.06	−1.40
	($p<0.001$)	($p<0.001$)	($p<0.001$)	($p<0.001$)	($p<0.001$)	($p<0.001$)
Cumulative percentage changes, 1990–2007 (%)	−11.1	−8.1	−14.3	−17.3	−19.0	−22.6
Physically active (%)						
1990–1995	11.5	11.7	13.4	11.1	18.8	12.9
1996–2001	11.0	10.1	12.9	11.2	20.9	15.2
2002–2007	16.6	18.7	21.5	24.8	32.6	32.0
1990–2007	12.8	12.4	16.7	17.0	25.5	22.5
Annual percentage changes (*p*-value)	0.36	0.60	0.62	1.09	1.07	1.53
	($p=0.02$)	($p=0.005$)	($p<0.001$)	($p<0.001$)	($p<0.001$)	($p<0.001$)
Cumulative percentage changes, 1990–2007 (%)	44.3	59.8	60.4	123.4	73.4	148.1

activity levels by occupation and educational levels. Most of the physically inactive were blue collar workers and people with basic education (14). Similar social gaps were also observed in obesity levels (15) and diabetes mellitus prevalence (16) in this population in northern Sweden. The widening gaps in levels of chronic diseases risk factors between social groups points out the important challenges in ensuring good health for the entire Swedish population.

Public health implications

Physical inactivity is a well-established causal factor in the development of many chronic diseases and is associated with reduced quality of life and increased mortality (3, 5, 17–20). The greatest improvements in health are seen among those who change from sedentary to even a low level of physical activity (21, 22). However, it is difficult to motivate people with sedentary lifestyles to adopt more physically active behaviours. The level of sedentary behaviour in our study population (cross-sectional data) did not change significantly during the study period. The panel data was contrary and showed a decreasing level of sedentary behaviour except among 30-year-old men with medium education. Behavioural modification is often difficult to achieve, particularly among those who lack motivation to change. Further studies using qualitative approaches should be conducted to increase our understanding of how people think about engaging in physical activity. Prevention efforts aimed at increasing physical activity should be a priority task for policy makers at all societal levels and should focus on those who are sedentary (1).

In industrialised countries such as Sweden, leisure time activities and modes of travel play important roles in influencing overall physical activity levels in the population. With its widespread geographical area and harsh long winters, many in the Västerbotten population commute by car or public buses. Public transportation is not developed to reach remote areas in the county and therefore commuting with cars is common (23). Those who work farther from home are more likely to commute by car. In

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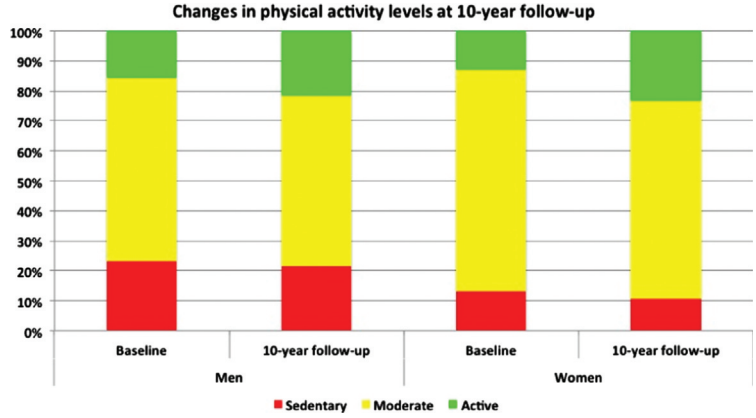

Fig. 2. Ten-year changes in prevalence of sedentary behaviour at the individual level by sex and education. Cohort data from the Västerbotten Intervention Programme.

contrast, people who work closer to home usually travel short distances by cycling or walking to work. Wennberg and colleagues reported that Västerbotten residents who regularly commute to work by car had an increased risk of myocardial infarction compared to those who rode the bus, bicycled, or walked (24). Most individuals with high education live in the Umeå municipality, which is the county centre of education and business. This municipality has a well-developed infrastructure of biking and walking lanes that provides safer and more convenient transportation and thus allows for more physical activity. Even during winter, many people bike or walk to work.

The VIP provides health counselling for participants including counselling on the importance of leading a physically active life. In recent years, a prescription of physical activity by physicians, physiotherapists, and nurses was introduced as a method to implement recommendations for increasing physical activity. Recent reports show that it is possible to incorporate the habit of physical activity prescription into routine primary care and leads to an increased physical activity level in the population (25). The panel data in our study show decreasing sedentary behaviour at 10-year follow-up. This might be a result of the advice given at the first VIP examination. Similar to trends in BMI development where an increasing trend of weight stability was demonstrated in a longitudinal analysis (26) before the slowing of the BMI increase was seen around 2000 in the cross-sectional analysis (15). It is possible that a cohort effect of decreasing sedentary behaviours is not yet apparent in the cross-sectional prevalences. The increasing trends of physically active behaviour and decreasing sedentary behaviour in the longitudinal analysis might be part of the explanation for this slowing of the obesity epidemic in northern Sweden. Our panel data are based on 1990–1997 VIP participants. During these years, results were provided to the participant by more direct counselling and based on a risk factor profile focused on biomedical measurements. Since 1990, all VIP nurses are trained in motivational interviewing in order to enable reinforcement of lifestyle changes that are aligned to individual preferences and possibilities. This allows the focus to be shifted towards lifestyle modification (11). Future studies need to assess whether this increases motivation to reduce sedentary behaviours.

Strengths and limitations of the study

This study has strengths of being long-standing, targeting the whole middle-aged population, and integrating into ordinary health care activities thus allowing evaluation of a large longitudinal population database. The study also has reasonable participation rates (about 70%) with minimal differences between participants and non-participants in both the cross-sectional (27) and longitudinal analyses. This rate is much higher than any other questionnaire survey in Sweden with current rates of about 40%. Our physical activity variable was created to capture both commuting activity and moderate and high intensity leisure time physical activity. The same questions have been used since the inception of VIP, allowing comparison of results over time, and contributes reliable data on population trends of physical activity.

However, the questionnaire did not assess physical activity during working hours and this might be a source of bias for those with manual occupations. We also did not attempt to quantify the distance people travelled on foot or on bike in their recreational time. Nor did we try to measure hours people spent on physical exercise. In addition, these self-reported questions on physical activity were not complemented with objective measures of physical activity. In this study, we observed a gradient of higher levels of biological risk factors (such as blood glucose, cholesterol, and systolic blood pressure) among those who are sedentary compared to those with higher levels of physical activity. For these reasons, we are confident that the physical activity measurement is valid.

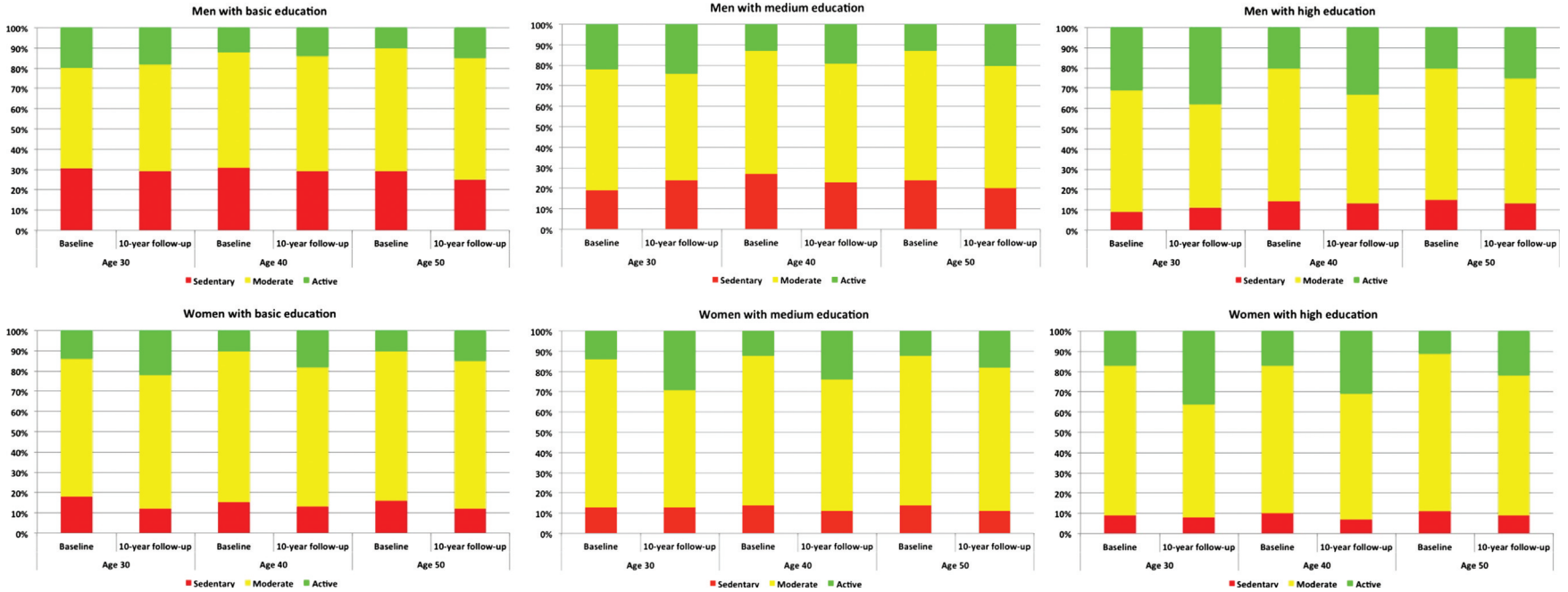

Fig. 3. Ten-year changes in prevalence of sedentary behaviour at the individual level by sex and education. Cohort data from the Västerbotten Intervention Programme.

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Table 3. Age-adjusted proportion of physical activity patterns at baseline and 10-year follow-up among men and women ($N = 26{,}382$)

Baseline	10-year follow-up		
	Sedentary	Moderate activity	Physically active
Men (%)			
Sedentary	10.2	11.3	1.8
Moderate activity	10.1	39.4	11.5
Physically active	1.1	6.6	8.1
Women (%)			
Sedentary	3.8	8.0	1.4
Moderate activity	6.4	51.8	15.9
Physically active	0.6	6.0	6.1

Note: Numbers represent percentage within each sex group.

Conclusion

Despite the promising evidence of increasing physical activity levels among the population in Västerbotten County, challenges remain for how to reduce the stable levels of sedentary behaviours in some subgroups as well as the increasing social gap between educational groups with regard to physical activity. A better understanding of how to motivate physically active behaviours – particularly among the sedentary population – will allow better formulation of targeted public health interventions.

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Conflict of interest and funding

The authors have declare no conflict of interest

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