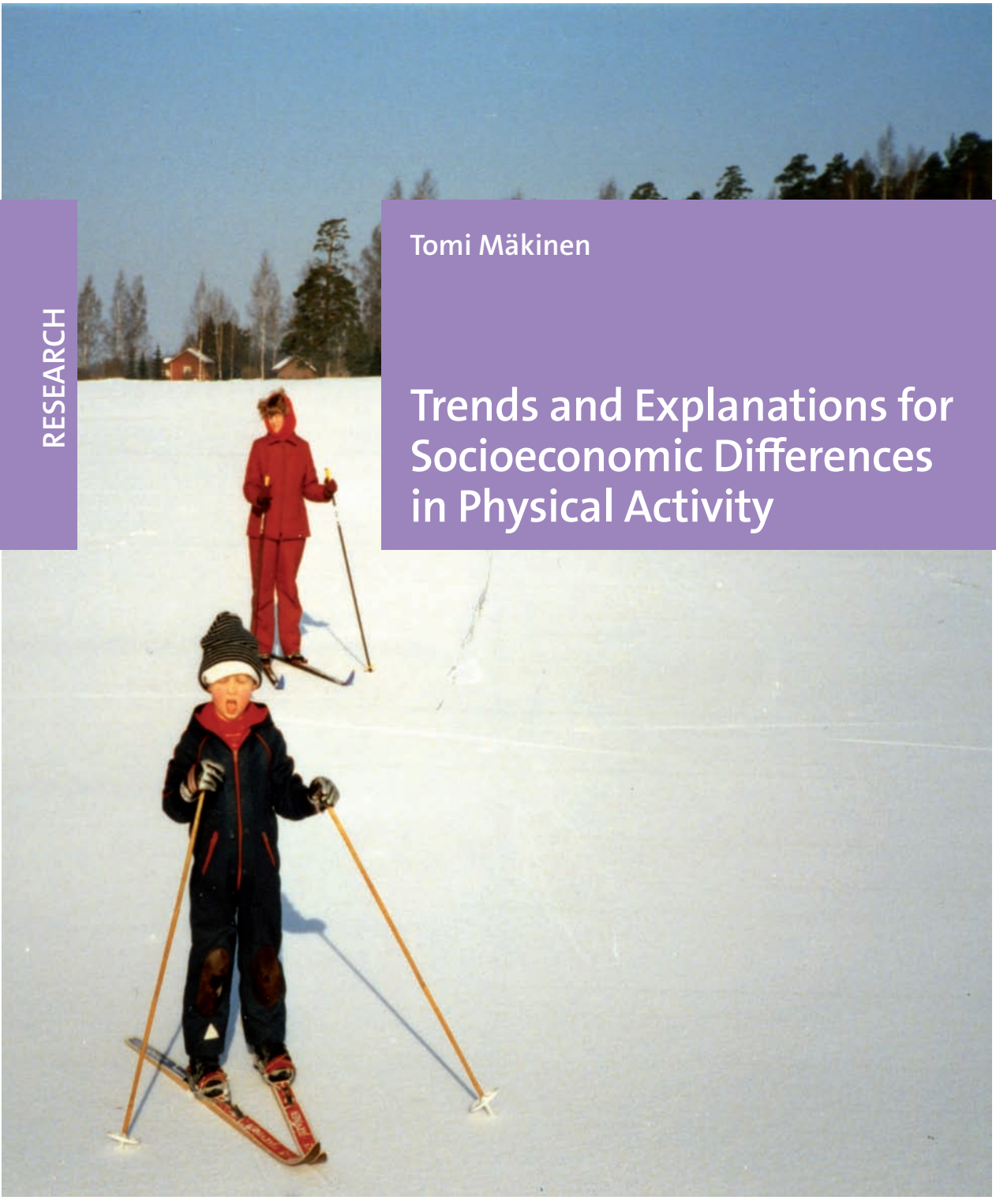

RESEARCH

Tomi Mäkinen

Trends and Explanations for Socioeconomic Differences in Physical Activity

RESEARCH 41

Tomi Mäkinen

Trends and Explanations for Socioeconomic Differences in Physical Activity

Academic Dissertation

To be presented with the permission of the Faculty of Medicine of the University of Helsinki for public examination in Auditorium XII, University Main Building

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Health and Welfare Inequalities, Department of Health, Functional Capacity and Welfare, National Institute for Health and Welfare, Helsinki, Finland

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“On aina matkalla jonnekin
ja minne ikinä päätyykin
on puolitiessä jostain
ja tietää sen varsin hyvin itsekin”

from ”Matkustaja” by Knipi

Abstract

Tomi Mäkinen. Trends and Explanations for Socioeconomic Differences in Physical Activity. National Institute for Health and Welfare (THL), Research 41, 138 pages. Helsinki, Finland 2010.
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Very limited scientific knowledge exists on the trends and explanations of socioeconomic differences in physical activity among adults. Potential social determinants could be parental socioeconomic position, childhood adversities, and earlier physical activity experiences. Moreover, own occupation, income, working conditions, and other adulthood health behaviours could explain socioeconomic differences in physical activity among adults. There is a paucity of studies examining whether these determinants vary across socioeconomic position and different life stages. This study examines a) how socioeconomic differences in leisure-time and commuting physical activity have changed in Finland from 1978 to 2002 and b) the contribution of childhood socioeconomic position, adolescence sports and exercise, adulthood socioeconomic position, working conditions and other adulthood health behaviours to socioeconomic differences in leisure-time physical activity.

This study utilised three population-based datasets collected by the National Institute for Health and Welfare (THL, formerly National Institute for Public Health): the Health Behaviour and Health among the Finnish Adult Population Study from 1978 to 2002 (N=96 105), the National FINRISK Study 2002 and its physical activity sub-study (N= 9 179), and the Health 2000 Study (N=8 028). Survey information was collected by self-administered questionnaires, interviews at home, and measurements made at the study site. The response rates varied from 69 to 89 per cent. Several socioeconomic measures were linked from the national population registers.

Based on the results, those with low income were physically inactive during leisure-time and while commuting from 1978 to 2002. Manual worker women, however, were more physically active commuters compared to their counterparts. Parental socioeconomic position contributed directly to adulthood educational differences in leisure-time physical inactivity but also indirectly through adulthood socioeconomic position (occupation, household income) and other unhealthy behaviours (mainly smoking). Among those with low education participation in competitive sports in youth and among those with high education exercise in late adolescence contributed to leisure-time physical activity in adulthood. Long exposure to physically strenuous

working conditions in men and current job strain in women contributed to occupational class differences in leisure-time physical activity.

Socioeconomic differences in physical activity have remained similar for twenty years in Finland. Educational career seems to have a strong contribution to physical activity. To adopt a lifelong physically active life-style, one should participate in a range of different sports and exercise in adolescence and in youth, have a low exposure to physically and mentally strenuous working conditions in later life and have other healthy behaviours in later life.

Keywords: physical activity, socioeconomic differences, trends, explanations, childhood circumstances, adolescence physical activity, adulthood living conditions, working conditions, social epidemiology, life-course perspective, adults, population-based, Finland

Tiivistelmä

Tomi Mäkinen. Trends and Explanations for Socioeconomic Differences in Physical Activity [Liikunta-aktiivisuuden sosioekonomisten erojen trendit ja selitykset]. Terveyden ja hyvinvoinnin laitos (THL), Tutkimus 41, 138 sivua. Helsinki 2010. ISBN 978-952-245-351-8 (painettu); ISBN 978-952-245-352-5 (pdf)

Liikunta-aktiivisuuden sosioekonomisten erojen trendeistä ja eroja selittävistä tekijöistä tiedetään hyvin vähän. Mahdollisia selittäviä tekijöitä voivat olla vanhempien sosioekonominen asema, lapsuuden sosiaaliset ongelmat ja aikaisemmat liikuntakokemukset. Myös oma ammattiasema ja tulot sekä työolot että muu aikuisiän terveyskäyttäytyminen voivat mahdollisesti selittää liikunnan sosioekonomisia eroja. Vain harva tutkimus on kuitenkin tarkastellut sitä, vaihtelevatko nämä selittävät tekijät sosioekonomisen aseman ja elämänvaiheen mukaan. Tämä tutkimus tarkastelee a) miten vapaa-ajan liikunnan ja työmatkaliikunnan sosioekonomiset erot ovat kehittyneet suomalaisilla aikuisilla vuosina 1978–2002 ja b) ovatko vapaa-ajan liikunnan sosioekonomiset erot aikuisilla selitettävissä lapsuuden sosioekonomisilla tekijöillä, nuoruuden liikunta-aktiivisuudella, aikuisuuden sosioekonomisilla tekijöillä, työoloilla ja muulla terveyskäyttäytymisellä.

Tämä tutkimus hyödynsi kolmea koko Suomen väestöä edustavaa poikkileikkausaineistoa joiden keräämisestä Terveyden ja hyvinvoinnin laitos (THL, aikaisemmin Kansanterveyslaitos KTL) on ollut vastuussa: Suomalaisen aikuisväestön terveyskäyttäytyminen ja terveys -tutkimus vuodesta 1978 vuoteen 2002 (N=96 105), Kansallinen FINRISKI -tutkimus 2002 ja sen liikunta-alaotos (N=9 179) sekä Terveys 2000 -tutkimus (N=8 028). Tutkimustieto kerättiin joko kyselylomakkeilla ja haastatteluilla kotona tai tutkimuspaikalla. Mittaukset tehtiin tutkimuspaikalla. Tutkimusten vastausaktiivisuus vaihteli 65 %:sta 89 %:iin. Sosioekonomiset tiedot yhdistettiin aineistoihin väestörekistereistä.

Pienituloiset pysyivät inaktiivisina niin vapaa-ajallaan kuin työmatkoillaan vuosien 1978 ja 2002 välillä. Poikkeuksena olivat työntekijäammattiasemassa olevat naiset, jotka ovat olleet aktiivisempia työmatkaliikkujia verrattuna muissa ammattiasemissa oleviin. Liikunnan koulutuserot näyttäisivät osittain johtuvan vanhempien sosioekonomisesta asemasta, mutta myös aikuisuuden sosioekonomisella asemalla (ammattiasema, tulotaso) ja muilla elintavoilla (lähinnä tupakoinnilla) oli vaikutuksensa. Matalasti koulutetuilla kilpaurheilun harrastaminen nuoruudessa ja korkeasti koulutetuilla kuntoliikunnan harrastaminen varhaisaikuisuudessa ennusti vapaa-ajan liikunta-aktiivisuutta aikuisuudessa. Myös pitkä altistuminen fyysisesti raskaille työoloille miehillä ja henkisesti raskas nykyinen työ naisilla selittivät osittain ammattiryhmittäisiä eroja vapaa-ajan liikunnassa.

Liikunnan sosioekonomiset erot ovat jo pitkään pysyneet samankaltaisina Suomessa. Erityisesti koulutusuralla näyttäisi olevan voimakas yhteys liikuntaan. Tekijät, jotka auttavat omaksumaan elinikäisen liikunnallisen elämäntavan ovat lapsuuden ja nuoruuden liikunta, myöhempien elämänvaiheiden vähäinen altistuminen fyysisesti ja henkisesti raskaille työoloille ja muutenkin terveelliset elintavat.

Avainsanat: Liikunta-aktiivisuus, sosioekonomiset erot, trendit, selittävät tekijät, lapsuuden elinolot, nuoruuden liikunta-aktiivisuus, aikuisuuden elinolot, työolot, sosiaaliepidemiologia, elämänkulkunäkökulma, aikuiset, väestötutkimus, Suomi

Sammanfattning

Tomi Mäkinen. Trends and Explanations for Socioeconomic Differences in Physical Activity [Trender och förklaringar av socioekonomiska skillnader i fysisk aktivitet]. Institutet för hälsa och välfärd (THL), Forskning 41, 138 sidor, Helsingfors 2010. ISBN 978-952-245-351-8 (tryckt); ISBN 978-952-245-352-5 (pdf)

Det finns mycket lite vetenskaplig kunskap om de faktorer som förklarar trenderna inom och de socioekonomiska skillnaderna i fysisk aktivitet bland vuxna. Potentiella faktorer som förklarar de socioekonomiska skillnaderna i fysisk aktivitet kan vara föräldrarnas socioekonomiska ställning, negativa upplevelser i barndomen och tidigare erfarenheter av fysisk aktivitet. Dessutom kan det egna yrket och de egna inkomsterna samt arbetsmiljön och annat hälsobeteende eventuellt förklara de socioekonomiska skillnaderna i fysisk aktivitet. Endast ett fåtal studier har dock undersökt om dessa faktorer varierar beroende på socioekonomisk position och fas i livet. Denna studie undersöker a) hur de socioekonomiska skillnaderna i fysisk aktivitet på fritiden och under resor till arbetet har förändrats hos den vuxna befolkningen i Finland under åren 1978–2002 och b) om de socioekonomiska skillnaderna i den fysiska aktiviteten hos vuxna kan förklaras med socioekonomiska faktorer i barndomen, utövande av idrott och motion i tidig vuxen ålder, socioekonomiska faktorer i vuxen ålder, arbetsmiljön och annat hälsobeteende.

Denna studie utnyttjade tre tvärsnittsdatabaser som representerar Finlands befolkning, samtliga sammanställda av Institutet för hälsa och välfärd (THL, tidigare Folkhälsoinstitutet): studien Den finländska vuxna befolkningens hälsobeteende och hälsa 1978–2002 (N = 96 105), Den nationella studien FINRISKI 2002 och dess motionssampel (n = 9 179) samt studien Hälsa 2000 (n = 8 028). Forskningsdata samlades in antingen genom frågeformulär och intervjuer hemma eller på platsen för studien. Mätningarna utfördes på platsen för studien. Svarsfrekvenserna varierade mellan 69 och 89 procent. De socioekonomiska uppgifterna kopplades till materialet från det nationella befolkningsregistret.

Resultaten visar att personer med låg inkomst fortsatt var fysiskt inaktiva både på fritiden och under sina resor till arbetet under åren 1978–2002. Undantaget var de yrkesverksamma kvinnorna, som har varit fysiskt aktiva under sina resor till arbetet jämfört med övriga yrkesverksamma. Föräldrarnas socioekonomiska ställning verkar ha en viss inverkan på skillnader i utbildning och fysisk aktivitet, men även den socioekonomiska ställningen (yrke, inkomst) som vuxen och andra levnadsvanor (främst rökning) hade en viss effekt. Bland lågt utbildade kommer de som har utövat tävlingsidrott i ungdomen och bland högt utbildade de som har utövat motionsidrott i tidig vuxen ålder att vara fysisk aktiva på fritiden även i vuxen ålder. Likaså bidrar till viss del långvarig exponering för en fysiskt ansträngande arbetsmiljö hos män och nuvarande exponering för psykiskt ansträngande arbete hos kvinnor till skillnaderna mellan olika yrkesgrupper när det gäller fysisk aktivitet på fritiden.

De socioekonomiska skillnaderna i fysisk aktivitet har varit oförändrade i Finland under en längre tid. I synnerhet utbildningskarriären verkar ha ett starkt inflytande på den fysiska aktiviteten. För att man ska tillägna sig en livslång fysiskt aktiv livsstil ska man ha tillägnat sig positiva motionsvanor i barndomen och ungdomen, ha en låg exponering för fysiskt och psykiskt ansträngande arbetsmiljöer senare i livet och ha sunda vanor i övrigt.

Nyckelord: Fysisk aktivitet, socioekonomiska skillnader, trender, förklara factor, bardom factor, ungdom fysisk aktivitet, vuxen factor, arbetsmiljö, social epidemiologi, livstid perspektiv, vuxen, population studie, Finland

CONTENTS

List of original publications

I Mäkinen Tomi, Borodulin Katja, Laatikainen Tiina, Fogelholm Mikael, Prättälä Ritva. Twenty-five year socioeconomic trends in leisure-time and commuting physical activity among employed Finns. Scandinavian Journal of Medicine & Science in Sports 2009: 19: 188–197

II Mäkinen Tomi, Kestilä Laura, Borodulin Katja, Martelin Tuija, Rahkonen Ossi, Prättälä Ritva. Effects of childhood socioeconomic conditions on educational differences in leisure-time physical activity. European Journal of Public Health 2010; 20(3):346-53. Epub 2009 Nov 30.

III Mäkinen Tomi, Borodulin Katja, Tammelin Tuija, Rahkonen Ossi, Laatikainen Tiina, Prättälä Ritva. The effects of adolescence sports and exercise on adulthood leisure-time physical activity in educational groups. International Journal of Behavioural Nutrition and Physical Activity 2010: 7:27

IV Mäkinen Tomi, Kestilä Laura, Borodulin Katja, Martelin Tuija, Rahkonen Ossi, Leino-Arjas Päivi, Prättälä Ritva. Occupational class differences in leisure time physical inactivity: the contribution of past and current physical workload and other working conditions. Scandinavian Journal of Work, Environment & Health 2010: 36(1): 62–70

Abbreviations

95%CI	95% Confidence Intervals
AVTK	Health Behaviour and Health among the Finnish Adult Population
BMI	Body Mass Index
CFI	Comparative Fit Index
CPA	Commuting Physical Activity
FINRISK	National FINRISK Study
H2000	Health 2000 Study
LTPA	Leisure-time Physical Activity
LTPI	Leisure-time Physical Inactivity
OR	Odds Ratio
OPA	Occupational Physical Activity
PA	Physical Activity
PE	Physical Education
PI	Physical Inactivity
RMSEA	Root Mean Square Error of Approximation
SEM	Structural Equation Modelling
SEP	Socioeconomic Position
THL	National Institute for Health and Welfare
TLI	Tucker-Lewis Index
WHO	World Health Organization
WRMR	Weighted Root Mean Square Residual

1 Introduction

Sports and exercise are part of the Finnish identity. Many Finns participate in physical activity almost on a weekly basis and, for example, jogging has been hugely popular in Finland for many years (Martiskainen and Hannus, 2006, Mladovsky et al., 2009, Martinez-Gonzalez et al., 2001). Several phenomena and institutions have shaped the Finnish culture to endorse sports and exercise. The Finnish Federation of Gymnastics and Sports (established in 1900), the Finnish Athletics Federation (founded in 1931) and phenomena such as the Stockholm Olympics in 1912, the golden era of five Olympic Games in 1920–36, and Olympic Movement in 1952 have had an impact on many Finns. Many famous Finnish athletes such as Paavo Nurmi, Seppo Räty, Valentin Kononen, Elin Kallio, Tiina Lillak, and Sari Essayah put Finland on the world map and introduced sports and exercise into the homes of many Finns (Heikkinen et al., 1992, Martiskainen and Hannus, 2006, SLU, 2006).

Today's Finns in good health, eat healthier, live longer, and are more educated than the older generations. Although the health and well-being of Finns has improved, the socioeconomic differences in health and health behaviours have remained unchanged or even widened (Palosuo et al., 2007). Moreover, leisure-time physical activity has become an important sphere of life, a way for many Finns to spend time with friends and take their minds off work. Physical activity provides the means to find mental and physical experiences that are no longer found in other ways. People try to pursue health and well-being for themselves by being physically active (Pyykkönen, 2008).

Physical inactivity has, however, become one of the leading causes of death in the 21st century. Every second individual worldwide fails to meet the recommended physical activity. (Brownson et al., 2005, Haskell et al., 2007, WHO, 2004) Despite the importance of physical activity in Finnish society, many Finns also fail to meet the recommendations for physical activity: approximately half of the adolescents and one third of the adults. To meet the recommendations, adults should engage moderate physical activity for a total of 2 h and 30 min per week or vigorous physical activity for 1 h and 15 min per week. One should also do exercises to maintain or improve muscular fitness and flexibility at least two times per week. Adolescents should do 1 to 2 hours of daily physical activity to meet the recommendations. (UKK Institute, 2009, Prättälä and Paalanen, 2007, Fogelholm et al., 2007, Helakorpi et al., 2008, Tammelin and Karvinen, 2008)

Those with high socioeconomic position are more likely to be physically active than those with low socioeconomic position (Gidlow et al., 2006). From the Finnish

perspective, several institutions may have had an influence on the existence of socioeconomic differences in physical activity at the population level: the nine-year compulsory education, including physical education and skiing holidays, affects all individuals, and the Finnish Workers' Sports Federation promotes sports and exercise among workers. (Pyykkönen, 2007, Martiskainen and Hannus, 2006, Vuolle, 1998) In 1988, Bernard Marti and his research group were among the first researcher to find socioeconomic differences in physical activity among Finns(Marti et al., 1988). The research group, however, examined only Finns living in Eastern Finland and not the whole population. Until recently, it was not clear whether socioeconomic differences in physical activity exist among Finnish population. Surprisingly, such differences do exist. Lower educated Finns reported lower levels of total leisure-time physical activity and conditioning physical activity than the higher educated Finns (Borodulin et al., 2008b).

Several explanations for socioeconomic differences in physical activity have been suggested, ranging from negative early physical activity experiences to mentally and physically demanding working conditions (Popham and Mitchell, 2006, Wolin and Bennett, 2008, Ali and Lindström, 2006, Kouvonen et al., 2005). It has been suggested that the explanations for physical activity might even vary across socioeconomic groups (Droomers et al., 1998, Ball et al., 2006, Burton et al., 2003, Wardle and Steptoe, 2003, Kamphuis et al., 2007). Some suggest that the socio-economic differences in physical activity may be explained by psychosocial and material conditions as well as social capital (Wardle and Steptoe, 2003, Droomers et al., 2001, Droomers et al., 1998, Lindström et al., 2001). Physical activity might also be determined by social and cultural factors (Burton et al., 2003, Meyer et al., 2005, Schroder et al., 2004).

We need more scientific knowledge on how socioeconomic differences in physical activity have developed and how socioeconomic differences in physical activity among Finns can be explained. The framework of this study comes from social epidemiology, which examines the social distribution of different dimensions of health and their social determinants (Berkman and Kawachi, 2000). This study applies the life course perspective to examine how exposures to different physical, social and psychosocial factors during the lifespan affect the individual's physical activity in later life (Kuh and Ben-Shlomo, 2004a). This study focuses on individual social determinants, such as early experiences of physical activity, socioeconomic circumstances and working conditions which operate across the life course. By identifying whether those with low socioeconomic position have dropped out from the beneficial physical activity trend and assessing how socioeconomic differences in physical activity could be explained, we can more efficiently promote physical activity among those with low socioeconomic position.

2 Conceptual Framework

The next chapters will review the concepts and perspectives applied in this study. The first chapter will review the concept of socioeconomic position (SEP): the sociological traditions, and the strengths and limitations of the indicators of SEP used in this study. The second chapter introduces the concept of physical activity (PA): its different modes, types, and determinants as well as the limitations and strengths in measuring PA in population-based studies. The third chapter presents the life course perspective on socioeconomic differences in health.

2.1 Definitions of Socioeconomic Position

The association between SEP and health has been interpreted and influenced by three major sociological traditions: Marxian, Weberian and Functionalist (Aittomäki, 2008, Lynch and Kaplan, 2000). According to Karl Marx (Marx, 1889/1971, Marx and Engels, 1848/1888), the stratification of the society is based on the productive relations between humans and nature. In very simplified terms, the social classes emerged from the capitalist system where some owned property (factories, financial institutions etc.) and some did not. The propertyless proletariat had to sell their labour to the propertied bourgeoisie in order to live. The labour force, which was provided by the proletariat, enabled the bourgeoisie to get surplus value for their property. Therefore, the productional relationship between the proletariat and bourgeoisie both strengthens the class situation and results in inequality in living conditions.

Later on, Erik Olin Wright (Wright, 1985) developed the Marxian social classes by defining them according to exploitation. The class relationships were based on the unequal control and exploitation of capital, organisational, and skill or credential assets. Max Weber (Weber, 1948/1970, Weber, 1968/1978) thought that social classes were based on lack or possession of goods, abilities, and skills, which one might exchange for income. People in the same class position were thought to share the same "life chances", such as beliefs, values, and circumstances. The Functionalist tradition (Lynch and Kaplan, 2000) argued that society requires natural social stratification that is based purely on a system of social positions and not on the motives, values or aspirations of those in the same SEP.

For social epidemiologists, it was the Weberian "life chances" that guided the focus on such indicators of SEP as education, occupation and income. These indicators were thought to represent the skills, knowledge, and resources that individuals possessed. This formed the key element explaining the association between SEP and health. In the Weberian view, there existed four social classes: 1) "the working

class", who did the manual work, 2) "the petty bourgeoisie", i.e. the middle class, 3) "the propertyless intelligentsia and specialists", and 4) "the classes privileged through property and education" (Aittomäki, 2008, Lynch and Kaplan, 2000, Wagner et al., 2003, Weber, 1948/1970, Weber, 1968/1978). Later, area-based indicators of SEP have also been derived from censuses. Area-based measures of socioeconomic position include, for instance, information on unemployment, car and home ownership. This review will focus on the individual indicators of SEP.

Education is maybe the key indicator of SEP due to its ease of measurement, applicability to all regardless of employment status, and stability over adulthood. From the life course perspective, education represents the transition from parental socioeconomic position to own SEP. However, own SEP may be dependent on the parental SEP. Education might provide potential cognitive resources which influence on the individual's healthy choices. In addition, educational success may forecast future success: better jobs, higher income, good living area and better housing etc. Educational success or career might influence the social dimension; graduating from a well-known university might give useful social contacts, which help you to get a job but also provide you with symbolic social appreciation. (Krieger et al., 1997, Lynch and Kaplan, 2000)

Occupation links education to income. Occupation and working conditions are relevant structures in understanding the lives of humans, since work mainly dominates our daily lives. Many jobs expose individuals to health-damaging working conditions such as physical stress, noise or unsafe conditions. Health-damaging physical working conditions accumulate among those with low SEP. (Lynch and Kaplan, 2000, Lahelma et al., 2009, Aittomäki, 2008, Krieger et al., 1997) Besides the physical stressors of work, much attention has been paid to psychosocial working conditions (Lahelma et al., 2010). The work of Karasek (Karasek, 1979) has influenced the research on psychosocial working conditions. Karasek suggested in his two-dimensional demand-control model that psychosocial demands, decision latitude and social support at the workplace are relevant to the health of workers.

Income indicates directly the material conditions that might affect health. The health effects of income lie not in the possession of money itself but in the health implications of greater purchasing power. With more money, one can buy healthier food, use better quality health and medical care, and enjoy recreational services, including physical activity. Moreover, more money might also mean access to new skills, and the labour force of other individuals, and provide a buffer for unexpected stressful experiences such as sickness. (Lynch and Kaplan, 2000, Krieger et al., 1997) In addition, material conditions might affect psychological status, such as by resulting in cynical hostility or lower future expectations, which might lead

individuals to value their health less (Lynch et al., 1997, Wardle and Steptoe, 2003). It has been suggested (Schrijvers et al., 1999, Van Lenthe et al., 2002) that, compared to health behaviours, material conditions might have a stronger contribution to socioeconomic differences in health. On the other hand, material conditions and health behaviours might have independent contributions to socioeconomic differences in health (Laaksonen et al., 2005).

All the three indicators of SEP mentioned above have their downsides. The years of education might not tell us anything about the quality of education the individual has received or how the education is socially and economically valued. The value and appreciation of education have also varied remarkably between different time periods and cultures. Moreover, the current situation of the society, for example an economic booming or stagnation, might affect how good of a proxy the education is for material and economic well-being. (Lynch et al., 1994, Lynch and Kaplan, 2000, Krieger et al., 1997) Individuals who have no job and women who are not engaged in formal employment are excluded from the occupational classification, although belonging to either group may have a significant health burden, both physically and psychosocially.

The major limitation of income as an indicator of SEP is that studies are normally able to measure income only at one point in time and not over the whole life course (Lynch and Kaplan, 2000). Reverse causation, such as illness explaining income and vice versa, has been suggested as a limitation of using income as an indicator of SEP (Smith, 1999). This has, however, been shown not to explain the socioeconomic differences in health (Kestilä et al., 2009, Blane et al., 1993) or in mortality (Wolfson et al., 1993). Another aspect of income which should also be taken into account is that accumulated wealth could provide more exact information about health resources than current income, especially among retired persons. Using only income as an indicator of SEP that is, if we do not include liquid assets and other wealth, we might underestimate the true inequalities in health (Lynch and Kaplan, 2000). Household income might also give a truer picture than personal income, especially when other persons in the same household do not have regular earnings.

The choice of the SEP indicator should be based on the assumed effect of SEP on the applied health outcome. The choice may not always be the obvious one. There may be variation in what indicator of SEP is the most adequate at different life-stages (Davey Smith et al., 1998a, Davey Smith et al., 1998b). Some indicators of SEP are valid only at certain ages (Galobardes et al., 2007). Compulsory education is not completed until young adulthood: normally approximately at the age of 18 to 19 years. A person might find an occupation after the age of 16 years, but in some cases this happens much later in life. House ownership might be a good measure of socioeconomic position among middle-aged adults whereas wealth might be more

appropriate among older adults. Some measures can be collected at different times during the life course; using an array of SEP indicators gives more information about the possible mechanisms of how socioeconomic conditions might lead to poorer health over the life span (Galobardes et al., 2007). It has even been suggested that indicators of early-life SEP should be routinely included in population surveys and they should be used in monitoring the population's health and SEP as well as analysing the long-term policy effects (Chittleborough et al., 2006).

In this study, SEP is based on John Lynch and George Kaplan's definition where SEP means the "the social and economic factors that influence what position(s) individuals and groups hold within the structure of society, i.e., what social and economic factors are the best indicators of location in the social structure that may have influences on health." (Lynch and Kaplan, 2000). We approach social stratification from the social epidemiology perspective; our interest lies not in the social stratification itself but in how different experiences and their effects are socially distributed and how they contribute to the socioeconomic differences in PA over the life span.

2.2 Definitions of Physical Activity

In physical activity epidemiology, PA is defined as "any bodily movement produced by the skeletal muscles that results in energy expenditure" (Caspersen, 1989). PA is categorised with four basic dimensions: frequency (how many times you exercise), intensity (how hard you exercise), duration (how long you exercise non-stop), and type (ranging for example from tennis to walking) (Bouchard et al., 2006, Sallis and Owen, 1999b, Caspersen, 1989). In the context of sport sociology, it has been suggested by Richard Gruneau that all play, games and sports should be seen as forms of social practices in which people "interact and try to make themselves as agents in their association with other agents"(Gruneau, 1999). Socialisation into PA can causally be related to early involvement in play-games-sports due to family environment, school physical education (PE), sports heroes such as Paavo Nurmi and Teemu Selänne, health motives, or the influence of mass media. (Vuolle, 1998) The rules, traditions, and organisations that define games and sports should, therefore, be seen as both enabling and constraining factors for socialisation into PA. (Gruneau, 1999)

PA can be a way to distinguish oneself from other social classes (Cockerham et al., 1993). Especially in Finland, the activity of the Workers' Sports Federation (TUL) the inclusion of sports and exercise in the workers' movement. Later on, such achievements became more important and TUL invested more in competitive sports. (Vuolle, 1998) One could go even further as Gruneau (Gruneau, 1999) noticed among Canadians: those with higher class might participate in structured sports and games for reasons of fun, relaxation, and sociability as well as due to their

representational value whereas among the bourgeois values such as amusement and undisciplined "play" can be more important. Moreover, commercial sports have offered workers more appealing ways to fulfill their hunger for excitement and entertainment, such as amateur clubs and associations at workplaces.

In this study, PA is examined as health behaviour. In a Weberian context (Abel, 1991, Cockerham et al., 1993, Cockerham et al., 1997, Abel et al., 2000) we assume that people have both life chances and life conducts. The life conducts present the life choices available to people according to their life chances. For example people have different needs, goals, identities and desires that guide their PA choices, but people also have different chances and circumstances that may limit or promote their possibilities to achieve and maintain a high level of PA (Abel et al., 2000). Moreover, we assume that PA is a general indicator of a healthy life-style as suggested by Thomas Abel and David V. McQueen (Abel and McQueen, 1995). A healthy life style is, in the words of Thomas Abel and William C. Cockerham (Cockerham et al., 1997), "a collective pattern of health-related behaviour based on choices from options available to people according to their life chances". Therefore, the choice of PA is limited by chances such as access to PA facilities, low income or age.

PA is a complex phenomenon to examine at the population level (Sallis and Owen, 1999b, Pettee et al., 2009). If we want to capture "habitual" or daily PA, which reflects the long-term patterns of PA, we need proper assessment tools. We still lack a reasonable golden standard of measuring PA among free-living populations (Pettee et al., 2009), especially since we have to consider all the basic dimensions of PA (frequency, duration, intensity and type). Most population studies use questionnaires to capture the PA pattern, as questionnaire have been shown to have reasonable reliability and validity among adults (Sallis and Owen, 1999b). A recent study has shown that PA assessed by accelerometer and self-reported PA were very close to each other among adults whereas adolescents were prone to underreport their PA (Slootmaker et al., 2009). One, albeit expensive, way to ascertain the exact energy expenditure of PA is a doubly labelled water test. However, a doubly labelled water test does not give any information about an individual's PA pattern (Sallis and Owen, 1999b).

Recently, the use of heart rate and activity monitors has grown as an alternative way to measure PA at the population level. Activity and heart rate monitors make it possible to record PA patterns for several weeks with minute-by-minute accuracy, which helps to assess moderate and vigorous PA objectively. The problem with activity monitors is that they capture only vertical movement which is good for running and walking but not for bicycling, weight training or swimming. Moreover, activity monitors are not sensitive for carrying heavy objects such as backpacks. The

limitations of heart rate monitors are that they cannot distinguish between light and moderate PA according to heart rate, the chest strap can slip down and stop recording, and they are sensitive to interference from other electronic devices, which may cause data loss. Combined heart rate and activity monitors have been developed but so far only limited knowledge of their usability exist. (Pettee et al., 2009, Sallis and Owen, 1999b, Warren et al., 2010) Although the development of electronic monitors is ongoing, a questionnaire is very likely to remain the most common tool for assessing PA in population-based studies due to its low costs (Pettee et al., 2009).

PA can be divided into several modes that have different characteristics. Leisure-time physical activity (LTPA) is a personally chosen activity undertaken in an individual's free time that can be motivated by several reasons, such as health benefits, aesthetics, social contacts and fun. Exercise is a form of LTPA that is more planned, structured and aims at more specific objectives, for example the improvement of physical fitness. Physical fitness is a set of attributes that people have or have to achieve in order to perform daily activities or PA. In sports, the competition aspect plays an essential role in PA. Commuting physical activity (CPA) is an activity performed as a means of transportation (on foot or on a bicycle to and from work or school). Occupational physical activity (OPA) is PA that is carried out in a workplace such as sitting, standing, lifting items and climbing up the stairs. Household chores or domestic work include PA in household or nearby areas such as gardening, cleaning or caring for the elderly relatives. (Bouchard et al., 2006, Caspersen, 1989)

Physical inactivity (PI) is often categorised as the lower end of PA in order to catch those individuals who do not meet the current recommendations for health related PA (Haskell et al., 2007, UKK Institute, 2009, Tammelin and Karvinen, 2008). Sedentary behaviour is a distinct concept from PI. Sedentary behaviour refers to activities that do not increase energy expenditure such as sleeping, lying down, playing computer games, watching television or other screen-based entertainment (Pate et al., 2008). Sedentary behaviours and PI interrelate as well as associate with health outcomes uniformly (Gorely et al., 2009).

PA has various individual, cultural, and environmental determinants (Trost et al., 2002, Sallis and Owen, 1999a, Tammelin, 2005). Determinants at the individual level include, for example, demographics (age, gender, marital status), SEP (education, occupation, income), psychosocial factors (attitudes, enjoyment, self-efficacy), and behaviours (PA history, alcohol, smoking, diet), as well as skills (skill for coping with barriers). Cultural determinants include, for example, group cohesion and social support from friends and peers. Environmental determinants include factors such as access to facilities, climate, neighbourhood safety and

presence of sidewalks or cycling routes. In a large review for correlates of adulthood PA (Trost et al., 2002), SEP and self-efficacy had the strongest and most consistent positive associations to PA. Of the cultural determinants, social support either from one's spouse or from staff has the strongest positive association to PA. Physical environment determinants have also been reported (Ball et al., 2007) to contribute to PA such as walking.

PA also varies between genders (Kouvonen et al., 2005, Popham and Mitchell, 2006, Azevedo et al., 2007, Lallukka et al., 2004). Compared to women, men work more often in jobs that include high OPA (Borodulin et al., 2008a, Kouvonen et al., 2005). Differing from the general situation in Europe (Martinez-Gonzalez MA et al., 2001), Finnish women are more physically active during leisure-time and while commuting compared to men (Borodulin et al., 2008a, Borodulin et al., 2008b, Helakorpi et al., 2008). Women might also be more overburdened due to their high level of domestic PA compared to men (Kaleta and Jegier, 2007). However, domestic PA often only involves lower intensity PA that does not reach the level of assumed health benefits (Stamatakis et al., 2009, Lawlor et al., 2002).

2.3 Life Course Perspective

The life course perspective assumes that exposures to different physical, social and psychosocial factors during the lifespan affect the individual's health in later life (Kuh and Ben-Shlomo, 2004a). One of the pioneers of the life course perspective was Anders Forsdahl, who developed the socioeconomic deprivation -hypothesis. According to Forsdahl (Forsdahl, 1978) poverty experienced in childhood and adolescence followed by adulthood wealth was associated with higher risk for coronary heart disease. Another ground-breaking researcher was David Barker who created with his research group the concept of biological programming. Biological programming assumes that an individual's later health is already determined in utero due to the mother's malnutrition. Denny Vågerö and Raymond Illsley, however, suggested (Vågerö and Illsley, 1995) social programming as an alternative for biological programming. In social programming, an individual's later health is determined by childhood social conditions such as his or her family's social relationships during growth age, school experiences, school achievements, and transition to work life as well as changes in health behaviours.

The roots of adulthood health and health behaviours are suggested to lie in childhood (Kuh and Ben-Shlomo, 2004b, Lynch et al., 1997, Kestilä et al., 2006). Childhood may contribute to adulthood through various causal mechanisms (Kuh and Ben-Shlomo, 2004b), having an independent effect through clustering or triggering later poor exposures. The life course perspective (Ben-Shlomo and Kuh, 2002, Graham, 2002, Hertzman et al., 2001, Kawachi et al., 2002, Kuh et al., 2003, Kuh and Ben-Shlomo, 2004b) includes three theoretical models that could be

applied when examining the development of socioeconomic differences in health during the life span. The latency model assumes that exposures in utero and near birth can affect later health or development of disease. These detrimental exposures can include for example the mother's malnutrition or smoking and the individual's own birth weight and height. The accumulation model emphasises that exposures leading to poor health or disease can accumulate in certain individuals. Accumulation might be due to low parental or own SEP, which can expose the individual to several detrimental factors such as low birth weight, poor educational opportunities, and unhealthy behaviours.

The pathway model (Kuh and Ben-Shlomo, 2004a), also called "the chain of risk" model, is a special case of the accumulation model. The essential difference between the previous two models is that the pathway model assumes that detrimental exposure increases the risk for later exposures and the first exposure has an independent contribution to later disease risk or poor health. In the pathway model, the exposure can also act as a trigger for several later detrimental exposures where, however, only the last exposure increases the risk for disease or poor health. One should, however, remember that the three theoretical models are not completely mutually exclusive and the models cannot be separated empirically from each other.

Socioeconomic mobility is often attached to the life course perspective (Davey Smith and Lynch, 2004). Since the educational level has increased in welfare societies during the years, the most common case is upward socioeconomic mobility, where children achieve a higher educational level than their parents. Upward socioeconomic mobility has been found to have many beneficial health effects whereas intergenerational downward mobility may have negative health effects (Lynch et al., 1994). The assumed downward mobility can also be explained with different detrimental exposures in critical life-stages followed by accumulation of detrimental exposures in later life (Hallqvist et al., 2004, Kuh et al., 2003). It has been suggested (West, 1991) that health selection occurs during the life span: adulthood SEP would be due to for example childhood disease, height, overweight, smoking or use of drugs. It seems, however, that this kind of health selection has only a minor contribution to socioeconomic differences in health (Blane et al., 1993, Silventoinen et al., 2006, Wolfson et al., 1993).

3 Socioeconomic Differences in Physical Activity among Adults

With the exception of few studies, the knowledge of socio-economic differences in PA among adults has been gained during the 21st century. Population-based studies from the USA (Simpson et al., 2003), Canada (Barnett et al., 2007, Craig et al., 2004), and from European countries (Borodulin et al., 2008b, Aarnio et al., 2002b, Haskell et al., 2007, Kuh and Cooper, 1992, Salmon et al., 2000, Telama et al., 1997, Martinez-Gonzalez MA et al., 2001, Vaz de Almeida et al., 1999, Kaleta and Jegier, 2007) suggest that lower-educated people report lower levels of PA. A Finnish study (Borodulin et al., 2008b) demonstrated that the educational differences in PA were more prominent in fitness-related and in total PA than in daily PA such as domestic PA. In an Australian study (Ball et al., 2007), lower educated women were less likely to participate in both leisure-time and transport-related walking. In a Californian study (Berrigan et al., 2006), the low educated men were more likely to be physically active while commuting and doing errands compared to their highly educated counterparts.

Low occupational class (Wemme and Rosvall, 2005, Burton and Turrell, 2000) and low income (Gidlow et al., 2006, Iribarren et al., 1997, Wagner et al., 2003) are associated with a low level of LTPA. Current employment status and income may also explain almost half of the variation in LTPA in adulthood (Droomers et al., 1998). The consequences of poor financial position might explain the lower level of LTPA among the elderly and lower educated (Droomers et al., 2001). In a recent Australian study (Cerin and Leslie, 2008), physical barriers to walking and access to public space contributed to income differences in recreational walking whereas self-efficacy and social support explained all the educational differences in LTPA.

Some of the individual determinants of PA might vary depending on SEP, but there is a paucity of scientific knowledge on this area (Droomers et al., 1998, Ball et al., 2006, Burton et al., 2003, Wardle and Steptoe, 2003). Jane Wardle and Andrew Steptoe found (Wardle and Steptoe, 2003) that high SEP was associated with stronger health consciousness, belief in one's own influence on health, thinking more about the future and higher expectancies of a longer life-span. In a study using nationally representative data in the European Union (Zunft et al., 1999), the health barriers for participation in PA were more prominent among those with low SEP compared to their high SEP counterparts. Similar findings have also been reported

by other studies from the United Kingdom (Chinn et al., 1999) and Australia (Burton et al., 2003). In the EU, PA barriers related to work/study commitments were more commonly reported among those with high SEP than among those with low SEP (Zunft et al., 1999). Contradicting findings have been presented among Australian women, where those with low SEP more often reported work commitments as a significant barrier to PA (Ball et al., 2006). Social benefits have also been reported as a more important determinant of PA among those with high SEP compared to those with low SEP (Burton et al., 2003).

One study (Ball et al., 2006) has suggested that negative early life or family experiences in PA might be more common among women with low SEP than among their high SEP counterparts. Moreover, the same study found that well-rounded participation in physical activities during leisure-time was more common among those with high SEP than among those with low SEP (Ball et al., 2006). However, to our knowledge no population-based studies have examined whether earlier experiences and physical activity history could vary according to SEP and whether this might determine PA in later life.

4 Literature Review – Determinants of Physical Activity in Different Life-Stages

The following chapters will review the essential literature on individual social determinants of PA relevant to this study. Some of the other determinants of PA are also shortly mentioned but this review does not intend to be all-embracing. The main focus will be on childhood SEP, adolescence and youth sports and exercise, working conditions, and other adulthood health behaviours as well as body mass index (BMI).

4.1 Childhood Socioeconomic Position, Childhood Adversities and Parental Physical Activity

Low parental SEP associates with low LTPA in adolescence (Gordon-Larsen et al., 2000, Lasheras et al., 2001, McVeigh et al., 2004, Kantomaa et al., 2007, Sallis et al., 1999, Gorely et al., 2009, Inchley et al., 2005) and in adulthood (Tammelin et al., 2003a, Kuh and Cooper, 1992, Barnekow-Bergkvist et al., 1998, Pietilä et al., 1995, van de Mheen et al., 1998), but the association generally disappears when adjusting for own SEP (Kuh and Cooper, 1992, Blane et al., 1996, Wannamethee et al., 1996). Although this might largely be due to high correlation between parental and own SEP, some studies (van de Mheen et al., 1998, Huurre et al., 2003) have shown that the association between childhood SEP and adulthood PA remains after adjusting for adulthood SEP. Few studies (Kristensen et al., 2008, Kelly et al., 2006) that have measured PA objectively have reported that SEP is not associated with PA among children.

High family income associates with increased moderate to vigorous PA in adolescence (Gordon-Larsen et al., 2000) and with regular PA in children (Lehto et al., 2009). A Finnish study (Kantomaa et al., 2007) showed that high family income increases the likelihood of participating in sports and exercise such as badminton and tennis among boys and aerobics and dancing among girls.

The scientific evidence concerning the association between parental SEP and sedentary behaviour is inconsistent among children (Ball et al., 2009). Among adolescents, however, low parental SEP associates with sedentary behaviours such as time spent on watching TV (Kantomaa et al., 2007, McVeigh et al., 2004, Gorely

et al., 2009). High parental educational level associate with less time spent on watching TV (Kantomaa et al., 2007). Similar finding were found in a British study (Gorely et al., 2009), where girls with low parental SEP reported higher levels of sedentary behaviours than their counterparts with other levels of parental SEP.

Parental SEP, measured with father's occupation, at the age of 16 years might also predict PA in adulthood (Barnekow-Bergkvist et al., 1998). LTPI has been shown to be more common among young adults with manual worker parents than among their counterparts with non-manual parents (Huurre et al., 2003). Contradictory findings (Osler et al., 2008) also exist: father's occupational status was not related to LTPA in Danish middle-aged men. Moreover, the association between parental SEP and adulthood PA disappeared after adjusting for the level of adolescence PA (Tammelin et al., 2003a). Some evidence (Cleland et al., 2009) exists that high SEP and upward social mobility might associate with an increase in PA from childhood to adulthood.

Childhood adversities, such as parental long-term unemployment, parental financial difficulties, parental alcohol problem, parental mental illness and bullying at school, have rarely been examined as determinants of PA in later life. Childhood adversities may lead to unhealthy behaviours such as smoking (Kestilä et al., 2006) and heavy drinking (Kestilä et al., 2008) in young adulthood.

Besides parental SEP, parental PA may have a positive influence on children's (Godin et al., 1986, Moore et al., 1991, Perusse et al., 1989, Freedson and Evenson, 1991) and adolescents' PA (Gottlieb and Chen, 1985, Perusse et al., 1988). Some studies (Sallis et al., 1992), however, demonstrate that parental PA does not predict their the PA of the offspring. Parental PA has also been shown (Zahner et al., 2009) to predict higher participation in sports clubs among children. However, parental PA at the age of 13 did not significantly predict PA at the age of 25 (Campbell et al., 2001). It might be that parental or spousal encouragement to engage in PA also predicts adulthood PA (Dennison et al., 1988, Taylor et al., 1999). The perceived outcome of PA ("Is it worth it?") in boys and parental support in girls might also predict PA among those with low SEP (Dollman and Lewis, 2009). An intergenerational study (Aarnio et al., 1997) has suggested that there might be a substantial association between the PA of mothers and daughters at the very active and inactive ends of the PA continuum whereas no association was found between the PA of fathers and sons.

4.2 Youth and Adolescence Sports and Exercise

Those who participate in several sports after school hours in adolescence participate more regularly in LTPA compared to those who participate in only one sport (Aarnio et al., 2002b). Participation in running, cross-country skiing, and endurance sports in men, and running, track and field, and orienteering in women predict higher levels of adulthood PA (Aarnio et al., 2002b, Cox et al., 2008, U.S. Department of Health and Human Services, 1996). A prospective study (Kjonniksen et al., 2008) concluded that being involved in various types of PA in adolescence promotes lifelong involvement in PA.

LTPA associates with several sedentary behaviours such as TV and computer time among adolescents (Tammelin et al., 2007, Marshall et al., 2004, Santos et al., 2005, Utter et al., 2003). An inverse association between LTPA and amount of TV viewing time has been reported among boys and girls (Tammelin et al., 2007, Marshall et al., 2004, Todd and Currie, 2004). However, LTPA has been found (Utter et al., 2003, Santos et al., 2005) to associate positively with computer use. Adolescents could compensate for their sedentary behaviour by being physically active while commuting to and from school. It has been shown (Andersen et al., 2009) that adolescents who are active commuters to school have higher aerobic power, muscle endurance and flexibility compared to those who walked or were driven to school.

Youth tend to decrease their participation in PA when becoming adults (Tammelin, 2005, Telama and Yang, 2000). Tracking of PA during the lifespan has varied from low to moderate: the shorter the time-span between the two measurements the higher the correlates (Twisk et al., 1997, Malina, 1996, Tammelin, 2005). It has been suggested (Zick et al., 2007) that the decrease in PA from youth to adulthood might be due to a decline in team sport activities. Several longitudinal studies (Aarnio et al., 2002a, Kuh and Cooper, 1992, Nelson et al., 2005, Telama et al., 2005, Pietilä et al., 1995, Kelder et al., 1994), however, suggest that physically active individuals tend to remain physically active from adolescence to adulthood. Similar results have been found in another study (Barnekow-Bergkvist et al., 1998) where the performance PA tests at the age of 16 years predicted physical performance and PA at the age of 34. Moreover, it has been suggested (Kjonniksen et al., 2009, Zimmermann-Sloutskis et al., 2010) that belonging to a sports club in childhood associates positively with PA in adulthood as long as the involvement continues during adolescence.

Besides childhood and adolescence LTPA (Telama et al., 1997), physical education (PE) might also contribute to LTPA in adulthood (Kuh and Cooper, 1992). High participation in PE, including team and individual sports and academic clubs, predicts adulthood LTPA (Nelson et al., 2005). Average minutes of PE, however,

have been shown not to predict adulthood total PA or fitness (Cleland et al., 2008). Positive feedback from PE in the form of high PE grades might explain participation in LTPA in later life (Glenmark et al., 1994, Tammelin et al., 2003a). Moreover, PE experiences predict LTPA among students (Cox et al., 2008). PA also has a positive effect on educational career, as physically active individuals make better progress in their educational career than their physically inactive counterparts (Aarnio et al., 2002a, Kuh and Cooper, 1992). Although we have some information about how opinions on and enjoyment of PE associated with childhood and adolescence PA (Sallis et al., 1999), little information exists on whether opinions on PE also associate with PA in later life.

Recent studies (Cox et al., 2008, Lonsdale et al., 2009) have supported the notion that focusing on self-determined motivation might lead to greater enjoyment and higher PA level during school PE classes and also promotes PA outside school hours. Moreover, a recent study (Araujo-Soares et al., 2009) suggests that a combination of high levels of action and coping planning could increase PA among adolescents. Friendship groups might also be an important reason for participating in PA (Jago et al., 2009). Among girls, participation in PA depended on the norms of their friends whereas among boys physical activity was a positive attribute for social status. Friends initiated both girls and boys into PA via co-participation, modelling and verbal support as well as via spending time together.

4.3 Working Conditions

Occupational class not only represents the physical and mental environments where an individual spends most of the day but also sets time constraints, all of which can affect an employee's willingness to engage in LTPA. In particular, the amount of muscle work and its demands can influence motivation to participate in sports and exercise. Recently, it has been suggested that high OPA including either high aerobic work or lifting heavy weights could have negative health effects (Krause et al., 2007, Fransson et al., 2004) whereas LTPA might be beneficial regardless of high OPA (Fransson et al., 2004).

A classic Finnish study on PA patterns among workers is the METELI study (Kiviaho and Telama, 1975), which examined PA among machine industry employees. The METELI study examined very extensively, both in qualitative and in quantitative ways, different types and determinants of LTPA and CPA among 1640 persons working in three machine industry plants. Although the results cannot be generalised to Finnish populations, the study presented a good picture of physical activity among workers in one industry area which included different age-groups, both genders as well as individuals with different educational levels. According to the METELI study, the majority of the respondents thought that PA had an important role in their leisure-time activities and PA was also a healthy way to spend

free-time. However, only approximately one fifth of the workers participated in types of PA that were adequate enough for improving physical fitness. Among the machine industry workers, daily PA consisted more of CPA and domestic PA, especially among women, than of LTPA. Moreover, it was found that those with low OPA participated more often in LTPA than those with high OPA. High SEP, especially education, was also found to associate with higher level of LTPA. Therefore, the METELI research group concluded that those working in health damaging working conditions who have the greatest need for health-enhancing PA during leisure-time are not physically active enough.

In several studies, those with lower occupational status or those with high OPA have been reported to be less likely to participate in LTPA (Salmon et al., 2000, Burton and Turrell, 2000, Schneider and Becker, 2005, Popham and Mitchell, 2006). Contradictory findings, however, suggest that those with physically demanding work engage in vigorous exercise more often compared to those with physically less demanding work (Wolin and Bennett, 2008, Parsons et al., 2009, Lallukka et al., 2004, Wu and Porell, 2000). Moreover, the Whitehall II prospective cohort study (Gimeno et al., 2009) examined cumulative exposure to working conditions and found that exposure to passive jobs over 5 years associated with LTPI among men but not among women.

Mentally demanding work may influence participation in LTPA. Karasek's widely applied model, which combines job demands and job control, has yielded contradictory results (Karasek, 1979). Studies incorporating Karasek's model have suggested that high job strain (Kouvonen et al., 2005, Ali and Lindstrom, 2006) associates with LTPI whereas some studies suggest a weak or null association (Hellerstedt and Jeffery, 1997, Wemme and Rosvall, 2005, Lallukka et al., 2004). In a three country comparison study, inconsistent associations between job strain and PI were found in Finland, Japan and Britain (Lallukka et al., 2008). Another comparison study (Lahelma et al., 2010) from the same countries concluded that social class inequalities in PA cannot be explained with psychosocial working conditions. Further studies are, therefore, needed to understand the cultural, psychosocial, economic and social forces shaping the development of socioeconomic differences in LTPA in different countries.

Different time constraints such as long working hours (Popham and Mitchell, 2006, Schneider and Becker, 2005) and lack of time (Ball et al., 2006, Thomas et al., 2004, Booth et al., 1997, Kouvonen et al., 2005) may limit an individual's participation in LTPA. A British study (Parsons et al., 2009) showed that, among men, long working hours were not associated with LTPI inactivity but were associated with shorter duration of TV viewing.

4.4 Other Adulthood Health Behaviours and Body Mass Index

In this study, other adulthood health behaviours include smoking, excess alcohol consumption and unhealthy diet. Moreover, overweight and obesity, which are often measured by BMI or waist-to-hip-ratio, are seen as indicators of unhealthy behaviours. All these other health behaviours and overweight as well as obesity have detrimental health effects.

The burden of unhealthy behaviours, including PI, tends to be heavier among those with low SEP than among those with high SEP (Borodulin et al., 2010, Laaksonen et al., 2003). It has been suggested that those with low SEP value near-future pleasures more than future health (Wardle and Steptoe, 2003). Moreover, healthier behaviours might be more common among physically active that among physically inactive persons (Mensink et al., 1997). Recently it has been suggested (Meyer et al., 2008, Pate et al., 2008) that sedentary behaviour could be a good indicator of unhealthy behaviours.

PA is positively associated with weight maintenance and non-smoking (Kaleta and Jegier, 2007, Mensink et al., 1997, Martinez-Gonzalez et al., 1999). Overweight and obesity, measured with BMI, can generally be seen as indicators of unhealthy behaviours. Those with normal weight are more likely to eat healthy and participate in daily PA compared to those who are overweight or obese (Kruger et al., 2006). It has even been suggested that overweight would make participation in PA uninviting (Deforche et al., 2006). Those who participate in PA enough to meet the latest PA recommendations are less likely to be smokers compared to those who do not meet PA recommendations (Bertrais et al., 2004). Smoking seems to play a prominent role when determining other unhealthy behaviours (Laaksonen et al., 2001, Laaksonen et al., 2002).

Physically inactive men have been shown to use more alcohol, for example beer, compared to physically active men (Mensink et al., 1997). However, contradictory evidence exists, since persistent exercisers have been shown to be heavy alcohol users (Aarnio et al., 2002a). Among women and girls, similar findings were not found (Aarnio et al., 2002a, Mensink et al., 1997). Moreover, a change in alcohol consumption has been shown to associate with weight change but not with a change in PA (Laaksonen et al., 2002). In men, an increase in alcohol usage was associated with an increase in body weight whereas in women a decrease in alcohol consumption was positively associated with weight gain.

5 Aims of the Study

This study approached the socioeconomic differences in physical activity from the life course perspective. There may be several different mechanisms that operate during the life-span and generate socioeconomic differences in physical activity. Childhood socioeconomic position and adversities as well as early experiences of physical activity may contribute to adulthood physical activity by having an independent effect, clustering or triggering poor later exposures, either low socioeconomic position or physically demanding working conditions. Moreover, physical activity is not always determined by the chances (low socioeconomic position, childhood adversities, and physically demanding working conditions) but also by the choices that people make constrained by or regardless of their chances.

Socioeconomic position might affect an individual's leisure-time physical activity through various mechanisms. Education can represent the health knowledge adopted during one's educational career (Wardle and Steptoe, 2003) which guides an individual's choices on how to spend their leisure-time. Occupation and working conditions might indicate the need for either rest or the need for physical activity to compensate for a physically or mentally exhausting job (Wu and Porell, 2000, Wolin and Bennett, 2008). Income might indicate the material resources that one could use for example to participate in exercise or purchase a gym membership (Gidlow et al., 2006). Although occupational physical activity or physically strenuous working conditions contribute to daily total physical activity (Kouvonen et al., 2005), we assume that leisure-time physical activity has more positive physical and mental health as well as recreational benefits compared to occupational physical activity, since leisure-time physical activity is more volitional and one can choose one's own mode, type, duration and intensity.

The overall aim of this study was to explore the trends and explanations of socioeconomic differences in PA among adults. A special focus is on childhood and adolescence determinants and determinants operating over the life-span. The assumed associations are presented in Figure 1.

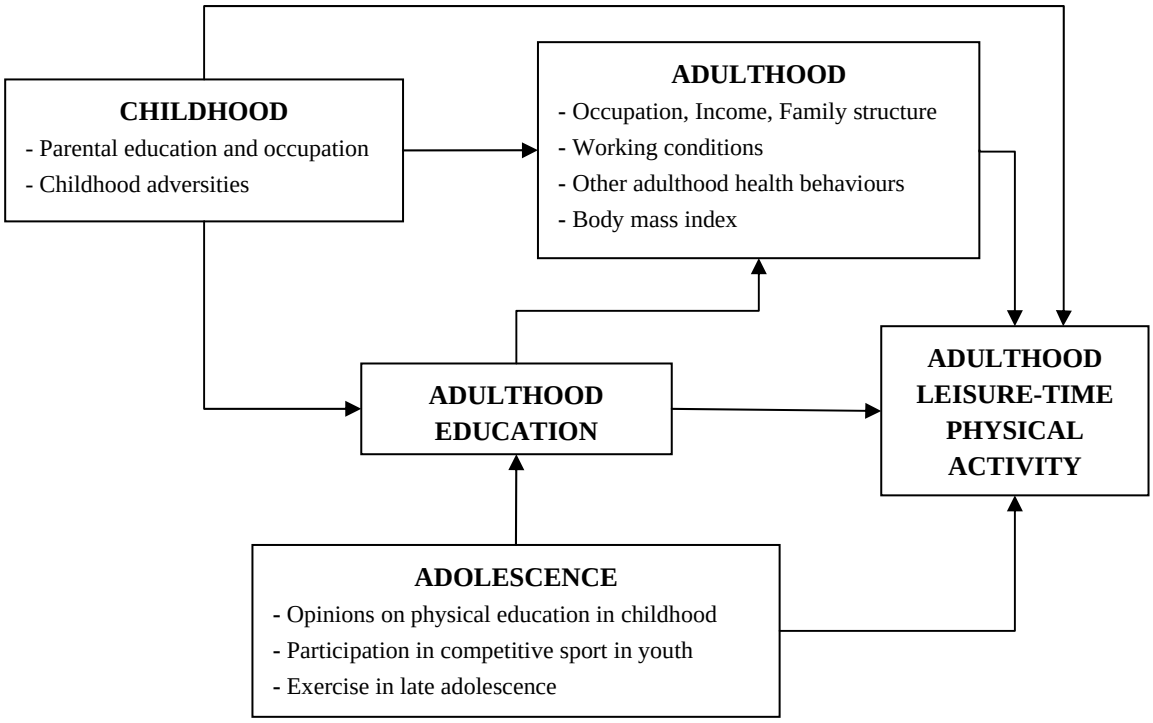

FIGURE 1 The assumed determinants of socioeconomic differences in leisure-time physical activity among adults examined in this study.

The specific aims were:

1) To examine how socioeconomic differences in leisure-time and commuting physical activity have developed among employed Finns from 1978 to 2002 (Study I)

2) To assess whether the socioeconomic differences in leisure-time physical activity among adult Finns could be explained by:

    a. Childhood socioeconomic position, childhood adversities, and adolescence sports and exercise (Studies II & III)

    b. Working conditions and other adulthood health behaviours as well as body mass index (Study IV)

6 Data and Methods

Three population-based surveys were utilised in this study: the Health Behaviour and Health among the Finnish Adult Population (AVTK), the Health 2000 Survey (H2000), and the National FINRISK 2002 study (FINRISK). The AVTK study provided information for examining the socioeconomic trends in PA and the H2000 Study and FINRISK Study were used to examine explanations for socioeconomic differences in PA. Information on respondents' education, occupation, and household income was linked to the data from the national population register (Statistics Finland).

6.1 Datasets

6.1.1 Health Behaviour and Health among the Finnish Adult Population

The dataset used in Study I was the Health Behaviours and Health among the Finnish Adult Population (AVTK) survey. The AVTK is a nationwide annually repeated cross-sectional survey with a random sample conducted by the National Institute for Health and Welfare (THL). The sample, including 5000 Finns aged from 15 to 64 years, is drawn from the national population register each year. The response rate has declined from 1978 to 2002 but remained fairly high: among women between 86% and 75% and among men 83% and 62% (Tolonen et al., 2006). The commonly accepted ethical regulations of THL concerning data collection, use, and reporting have been applied in the AVTK. No individual participants can be identified and only authorised persons have access to data at THL.

6.1.2 The Health 2000 Survey

In Studies II and IV, the analyses were based on the Health 2000 Survey (H2000). H2000 was a regionally stratified two-stage cluster sampling of Finns aged 30 and over which was carried out by THL in 2000–2001 (Aromaa and Koskinen, 2004). All the respondents filled a self-administered questionnaire and were interviewed. The response rate for the home interview was 89% and for the questionnaire 84%. The Ethics Committee of the National Public Health Institute and the Epidemiological and Public Health Ethics Committee of the Helsinki and Uusimaa Hospital District approved the H2000 protocol. All participants were informed about the study and signed a written informed consent, and trained personnel answered any further questions during the study.

6.1.3 The National FINRISK 2002 Study

In Study III, analyses were based on the National FINRISK 2002 study (FR2002) (National Institute for Health and Welfare, 2002). Data for FR2002 were collected using an area, gender, and age-group stratified random sample of Finns aged 25 to 74 years. The random sample was drawn from the national population register. Approximately two thirds of the original sample (N=13 436) were randomised into the FR2002 PA sub-study (N=9179). The participation rate was 60% for men and 70% for women. The WHO MONICA protocol (WHO, 1988) and the recommendations of the European Health Risk Monitoring Project (Tolonen et al., 2002) were applied in the FR2002 protocol. All the participants signed an informed consent. The FR2002 protocol was accepted by the Ethics Committee for Research in Epidemiology and Public Health.

TABLE 1 Datasets and variables used in Studies I-IV

STUDY:	**I**	**III**	**II & IV**
DATASETS:	**AVTK**	**FR2002**	**H2000**
N Age range Response rate	96105 15–64 65–84%	9179 25–74 65–89%	8028 30 and above 79–90%
Time period	1978–2002	2002	2000 & 2001
Sample	simple random sample	area, gender, and age-group stratified random sample	two-stage stratified random sample
Design	cross-sectional, time trend	cross-sectional, retrospective questions	cross-sectional, retrospective questions
OUTCOME:			
	LTPA (weekly frequency) CPA (daily amount)	LTPA (12 month recall, METh/week)	LTPA (the average frequency, duration and intensity during the year)
EXPLANATORY AND MEDIATING VARIABLES:			
Childhood	-	-	Parental education and occupation, family structure, adversities
Adolescence/youth	-	Participation in competitive sports in youth, exercise in late adolescence, opinions on PE	-
Adulthood	Education, occupation, and household income	Education	Education, occupation, household income, employment status, OPA, history of workload, present physical and psychosocial working conditions
Adulthood health behaviours and BMI	-	-	smoking, alcohol, BMI

6.2 Measurements

6.2.1 Adulthood Physical Activity

In Study I, LTPA was measured as the weekly frequency of exercise using the question: "How often do you exercise at least 30 minutes so that you sweat and get out of breath?" The response alternatives have changed to some extent over the years. The alternatives in study year 2002 were: daily, 4–6 times per week, 2– 3 times per week, once a week, 2–3 times per month, few times per year or less frequently and cannot do any exercise because of illness or disease. For the analysis, LTPA was dichotomised as those whose weekly frequency was twice or more (active) and those whose weekly frequency was less than twice (inactive). Those who could not do any exercise because of illness or disease where categorised as inactive.

Study I also examined CPA, which was measured as the daily amount of walking or cycling to and from work using the question: "How many minutes do you walk or cycle to and from work daily?" The response alternatives have changed to some extent over the years, but in 2002 the alternatives were: 1) "I am not working or I work from home", 2) "Use public transport or car during commuting", 3) "Less than 15 minutes per day", 4) "15–30 minutes per day", 5) "30–60 minutes per day", and 6) "Over an hour per day". CPA was dichotomised for the analysis: the active were those who had any daily commuting and the inactive were those who could not exercise because of their illnesses or used public transport or their car during commuting.

In Studies II and IV, LTPA was collected in the questionnaire with the item "How much do you exercise and strain yourself physically in your leisure time? (If there is major seasonal variation, select the option for your average situation)". Response alternatives were: 1) "I mainly read, watch television, or do other activities that do not strain me physically", 2) "I mainly walk, cycle, or move in other ways for at least 4 hours per week", 3) "I do vigorous PA more than 3 hours per week" or 4) "I participate regularly in competitive sports". In Study II, LTPA was categorised into three groups: inactivity (first response alternative), moderate activity (second response alternative), and high activity (the last two response alternatives). In Study IV, LTPA was categorised into two groups: inactive (first response alternative) and active (response alternatives from two to four). The PA questionnaire used in Studies II and IV originates from the Study of Men Born 1913 (Welin et al., 2003, Wilhelmsen et al., 1973, Grimby et al., 1972, Saltin and Grimby, 1968). This PA questionnaire has been found to strongly predict morbidity and mortality (Hu G et al., 2005, Barengo et al., 2006a).

In Study III, LTPA was collected with a detailed 12-month self-administered recall questionnaire, which has been validated in the Kuopio Ischemic Heart Diseases Risk Factor Study (Lakka and Salonen, 1992). A trained nurse instructed the participants in filling out the recall questionnaire. The recall questionnaire provided information on the frequency, duration and intensity of 23 of the most common types of PA, such as jogging, skiing, weight training, gardening, household chores, and walking/cycling to and from work (Borodulin, 2006). The outcome measure, total LTPA, was metabolic equivalents multiplied by hours per week (METh/wk), where 1 MET-hour equals energy expenditure of $1kcal*kg^{-1}*h^{-1}$ at rest. The metabolic cost of each PA was based on the Ischemic Heart Diseases Risk Factor Study protocol (Salonen and Lakka, 1987) and other internationally accepted norms (Ainsworth et al., 2000). For the analyses, the LTPA was log-transformed due to its skewness.

6.2.2 Adulthood Socioeconomic Position

Education (Studies I, II and IV) was drawn from the population registers (Statistics Finland, 1997a). In population registers, education is recorded as the last degree taken by the respondent. In Study I, to take into account the change in the general level of education in Finland over the years, we divided education into three groups based on the information on educational degree: high, intermediate, and low education. High education included those with technical college, university, post-graduate, and higher vocational degrees. Intermediate education included those with secondary education, and vocational training. Low education included those with primary education and those whose education status was unknown. In Studies II and IV, education was divided into three categories: high education (university or post-graduate level), middle education (tertiary level), and low education (secondary/primary level). In Study III, the participant's education was collected in the questionnaire as the years spent in full-time education. For analyses, education was dichotomised into two categories: those who had not graduated from senior high school (low education, less than 12 years spent in full-time education) and those who had a senior high school degree (high education, 12 years or more).

In Study I, occupation was based on the register data where it is recorded as the highest socioeconomic status in the household. Occupation was divided into six groups for the analysis: upper-level, lower-level employees, farmers, the self-employed, manual workers, and others. Upper-level employees included senior-level administrative, managerial, professional and related jobs. Lower-level employees included administrative, sales workers, and clerical occupations. Others included those whose occupation was unknown. In Studies II and IV, the participant's occupation was collected during the interview according to the Statistics Finland occupational classification (Statistics Finland, 1997b). For analyses, occupation was divided into white-collar (including legislators, senior officials, managers, professionals, technicians, associated professionals, clerks, service and care workers,

and retail sales workers) or blue-collar (including craftsmen and related trade workers, plant and machine operators and assemblers, and elementary occupations).

Household income (Studies I, II, IV) was drawn from the population registers. Household income included net income from the national tax register without income transfers. Household income was regarded as an annual net income per household consumption unit. Consumption units were calculated according to the OECD guidelines (OECD, 1982). The household's first adult person is given weight of 1.0, all the adults after that a weight of 0.7, and children under the age of 18 weights of 0.5. In Studies I, II and IV, household income per consumption unit was divided into income tertiles separately for genders: highest, medium, and lowest income tertile. In Study I, the income tertiles were calculated separately per study period to represent the relative change in income.

6.2.3 Childhood Socioeconomic Position and Adversities

The highest parental educational level and parental occupation were used as the indicators of childhood SEP in Study II. Parental education was divided into three groups: primary, middle and secondary education. Mother's and father's occupation was divided into five categories: office employee, manual worker, self-employed, farmer, and others.

Childhood adversities (Study II) before the age of 16 were collected retrospectively in the interview. Childhood adversities included long-term financial problems in the family, regular parental unemployment, parental divorce, parental alcohol problems, parental mental health problems and parental serious illness or disability, respondent's own serious chronic disease, and having been bullied at school. Each childhood adversity was categorised as a dichotomous variable: yes (had experienced specific childhood adversity before the age of 16) or no (had not experienced specific childhood adversity before the age of 16 or cannot say).

6.2.4 Youth and Adolescence Sports and Exercise

Opinions on PE in childhood, participation in competitive sports in youth, and exercise in late adolescence were collected retrospectively in adulthood (Study III). Opinions on PE included six statements on a scale of one (I entirely agree) to five (I entirely disagree) concerning the participants' PE during their school years. Two of these statements were included in this study: "PE was interesting and pleasant", and "I learned useful physical activity skills in PE classes". For analyses, each item was summarised into three categories: 1="I disagree", 2="I somewhat agree", and 3="I entirely agree".

Participation in competitive sports in youth was based on two questions: "At what age did you participate in competitive sports?" and "In what events did you

compete?". Three of the most commonly reported events such as running, cross-country skiing, and track and field were used in the analyses. In the analyses, those who participated into these events before the age of 15 were compared to those who participated in different events or did not participate at all in competitive sports in youth.

Exercise in late adolescence was collected with a question: How often did you exercise in your leisure-time (including jogging, cross-country skiing, cycling, swimming, walking, pole/Nordic walking, aerobics, ball games, ice hockey, etc.) at age of 15 to 24 years". For the analyses, it was divided into four categories: 1="once a week or less often", 2="from two to three times a week", 3="from four to five times a week", and 4="more than five times a week".

6.2.5 Working Conditions

History of physical workload (Study IV) was collected during the interview. The participant was asked to list all occupations in which he or she had worked for at least one year. Information on physical working conditions was collected for the most recent occupation, and a maximum of five previous occupations in which the respondent had worked for the longest periods. Few persons (about 1%) had had more than five jobs. The physical strenuousness of the previous occupations was asked with the question "How physically demanding was the occupation?" after which the following tasks were specified: "physically heavy work", "kneel or squat one hour per day", "drive a car, tractor or other work machine at least four hours per day", "manually lift, carry, or push items heavier than five kg at least twice per minute for at least two hours per day", "manually lift, carry, or push items heavier than 20 kg at least ten times per day", "work with hands above the shoulder level at least one hour per day", "work in a forward leaning position without support at least one hour per day", "perform work demanding great handgrip strength at least 1 hour per day", "continuous movements of the hands or wrists", "perform work with a vibrating tool at least two hours per day", and "work that requires standing or walking at least five hours per day". In addition, the respondents were also asked about the duration (in years) of their jobs involving these tasks. A cumulative sum index of years of exposure to each workload factor was calculated.

Current physically strenuous work was based on a summary variable, which included information on “lifting”, “carrying”, “poor working postures”, “working with hands above the shoulder level”, “working on your knees or squatting”, “strenuous work with hands”, and “repetitive hand motions” (Study IV). For analyses, it was divided from the mean into two categories: low and high.

Data on current job strain (Karasek, 1979) were collected in the self-administered questionnaire and data on current physically strenuous work, working hours, and work arrangements were collected in the interview (Study IV). Current job control and job demands (Karasek, 1979, Lallukka et al., 2004) were divided into two categories based on their mean scores: low and high control, and low and high demands. Job control and job demands were then cross-tabulated according to Karasek’s job-strain model into four categories: (1) high demands and low control, (2) low demands and low control, (3) low demands and high control, and (4) high demands and high control. Job demands and job control were also analysed separately.

Working hours (Study IV) were dichotomised at the mean to those working more than 38.5 hours per week and those working less. Work schedule (Study IV) was divided into three categories: regular, shift work, and other.

6.2.6 Other Adulthood Health Behaviours and Body Mass Index

Other adulthood health behaviours and BMI, compared to PA, were also examined in Studies II and IV. Smoking was collected with the interview and divided into four categories: non-smoker, former smoker, occasional smoker, and daily smoker (Helakorpi et al., 2004). Excessive alcohol consumption was collected with the interview and dichotomised according to the Finnish national clinical practice guidelines of weekly alcohol use (Salaspuro et al., 2005): less than the sex-specific risk limit or higher than the risk limit. The respondent’s body weight and height were measured by a trained nurse in the health examination.

BMI, as an indicator of adulthood unhealthy behaviours, was calculated by dividing weight in kilograms by height in square metres (kg/m2) and was classified as suggested by the WHO (WHO and FAO Expert Consultation, 2002): normal weight (18.5–24.9), overweight (25–29.9), and obesity (≥30).

6.2.7 Confounders and Background Variables

Research years were divided into five periods: 1978–1982, 1983–1987, 1988–1992, 1993–1997 and 1998–2002 (Study I). In Study I, respondents were divided into four age-groups: 25–34, 35–44, 45–54 and 55–64. In Studies II and IV, respondents were divided into five age-groups that, in addition to the previous four groups, included a 65+ age-group. In Study III, continuous age was used.

Information on cardiovascular, musculoskeletal, and respiratory diseases was collected in the clinical examination by physicians, according to detailed written instructions and uniform diagnostic criteria (Study IV).

6.3 Statistical Methods

Background and multivariate logistic regression analyses were done either with SAS Windows XP version 9.1.3 (SAS Institute Inc., Cary, NC) or with STATA 9.2 software (Statacorp, 1984-2007). Structural equation modelling was done with MPLUS 5.2 software (Muthén and Muthén, 2007).

All the analyses (Studies I-IV) were done separately for women and men in order to see whether the associations followed the same pattern in both genders. Basic results were presented as correlations, prevalences (%), means (M), and medians (ME). Standard deviations (SD) are shown for mean values and 25th and 75th percentiles for median values. Chi^2 p-values were also calculated to examine the statistical significance of group differences. In addition, Cronbach's alpha (α) was calculated to examine internal reliability for summary variables. The multivariate results are presented as odds ratios (OR) and 95% confidence intervals (95%CI).

In Study I, 25-year socio-economic trends in LTPA and CPA were examined using logistic regression and a total time trend index. In Study II, the direct and indirect effects of childhood socioeconomic conditions on educational differences in leisure-time physical activity were examined with sequential logistic regression. In Study III, structural equation models with latent variables were applied to examine how adolescence sports and exercise determined adulthood LTPA in educational groups. In Study IV, the contribution of past and current workload and other working to occupational class differences in LTPI was examined with sequential logistic regression analysis. The more specific details of statistical analyses applied in the studies can be found from the original publications. Table 2 presents the applied statistical methods, dependent and independent as well as adjusted variables used in the studies.

TABLE 2 Statistical methods, variables as well as exclusions used in the Studies I-IV

STATISTICAL METHOD	DEPENDENT VARIABLES	INDEPENDENT VARIABLES	ADJUSTMENTS	STRATIFICATIONS	EXCLUSIONS/ FINAL DATA
Sequential Logistic Regression	**LTPA:**	Education, occupation, and household income	Age	Gender and research period	Aged < 25 years (N=16 078)
	1) ≥ 2 times/week				Students (N=1 403)
	0) < 2 times/week (ref.)				Unemployed (N=3 104)
	CPA:				Housewifes, retirees, those under institutional care (N= 10 303)
	1) Those who had daily CPA				Missing cases (N=1 895)
	0) Those who could not exercise due to illness or used public transport or their car				**Final data: 25 513 women and 25 302 men**
Sequential Multinomial Logistic Regression	**LTPI AND MODERATE PA:**	Father's and mother's education and occupation, childhood adversities, own education and occupation, household income, main economic activity, family structure, smoking, excess alcohol consumption, and BMI	Age	Gender	**Final data: 4 391 women and 3 637 men**
	1) reading, watching TV or doing minor				
	2) walking, cycling or moving other ways <				
	3) vigorous PA >3h/week or compatitive sports (ref.)				
Structural Equation Models and Latent Variables	**Total LTPA:**	Opinion on PE, participation in competitive sports in youth, and exercise in late adolescence	Age	Gender and education	Aged ≥ 65 years (N=692)
	12-month recall on frequency, duration, and intensity for 23 of the most common types of PA, METh/week				Insufficient information in the 12-month recall (N=830)
					Final data: 2 490 women and 1 918 men
Sequential Logistic Regression	**LTPI:**	Occupation, history of physical workload, current physical strenuous work, job strain, working hours, work schedule	Age, diagnosed chronic diseases, education, household income, BMI, and smoking	Gender	Unemployed during the previous 12 months (N=2 625)
	1) reading, watching TV or doing minor				Aged ≥ 65 years (N=594)
	0) walking, cycling, moving other ways < 4h/week, vigorous PA >3h/week or compatitive sports (ref.)				Farmers (N=N239)
					Entrepreneurs (N=168)
					Military personel (N=24)
					Missing cases (N=107)
					Final data: 1 795 women and 1 560 men

7 Results

7.1 Determinants and Socioeconomic Differences for Physical Activity among Adult Finns

TABLE 3 Socioeconomic differences in physical activity among adult Finns. Age-adjusted prevalence (%) and 95% confidence intervals (95%CI). (Unpublished work)

	Occupational physical activity (H2000: physically strenuous work)				Commuting physical inactivity (AVTK2002: no daily CPA)				Leisure-time physical inactivity (H2000: no physical activities)				Total leisure-time physical inactivity (FINRISK 2002: do not fulfill the latest PA recommendations[d])			
	WOMEN		MEN		WOMEN		MEN		WOMEN		MEN		WOMEN		MEN	
Education[a]	%	95%CI	%	95%CI	%	95%CI	%	95%CI	%	95%CI	%	95%CI	%	95%CI	%	95%CI
High	4	2-6	3	1-5	47	42-52	62	57-68	22	18-27	20	16-25	14	12-17	20	17-23
Middle	32	29-34	40	37-43	48	43-53	66	61-71	26	24-28	26	23-28	19	16-21	24	20-27
Low	49	44-54	58	53-62	47	38-57	72	64-80	33	30-36	33	30-36	29	25-32	30	26-33
Occupational class[b]																
Non-manual worker	24	22-26	17	14-19	44	37-48	61	55-65	26	24-27	24	21-26	17	15-18	20	17-22
Manual worker	58	53-64	65	62-69	48	41-55	66	61-71	32	29-35	32	29-34	31	22-39	29	25-32
Household income[a]																
Highest tertile	24	21-26	28	25-32	44	38-50	66	60-72	23	21-25	25	22-27	15	12-18	19	16-23
Middle tertile	34	30-38	43	39-47	46	40-51	65	60-71	27	25-29	25	22-28	21	19-24	24	21-28
Lowest tertile	44	39-49	57	52-52	53	47-58	69	64-74	36	27-30	35	31-38	23	20-26	27	23-31

a: Education In AVTK2002 and in H2000 stands for the last taken degree whereas in FINRISK2002 education is based on the years of full time education

b: Occupation in AVTK2002 and H2000 is based on the register information of the occupational class whereas in the FINRISK2002 occupational status is self-reported

c: Household income in AVTK2002 and H2000 is based on register information and divided by consumption unit whereas in the FINRISK2002, the household income is self-reported and divition by consumption unit is in line with the OECD quidelines

d: ACSM/AHA Recommendations for health-enhancing physical activity (Haskell et al. 2007 Circulation)

Among adult Finns, one third of those with low education was physically inactive during leisure-time and did not fulfill the recommendations for health-enhancing PA (Table 3). Moreover, nearly half of those with low education were physically inactive while commuting. Those with low education were, however, more physically active at work than those with high education. As for occupational class, nearly two thirds of those working in manual jobs were more physically active at work compared to their other occupational counterparts. As for CPA and LTPI, their association with occupational class was similar to their association with education. Approximately one third of those with low household income were physically inactive during leisure-time. Every other person with low household income was also physically inactive while commuting. OPA was, again, more prominent among those with low household income than those with high household income.

TABLE 4 The examined childhood, adolescence and youth determinants of adulthood leisure-time physical inactivity among Finns. Age-adjusted prevalence (%) and 95% confidence intervals (95%CI). (Unpublished work)

	Leisure-time physical inactivity[a]			
	WOMEN		MEN	
CHILDHOOD SOCIOECONOMIC CIRCUMSTANCES	**%**	**95%CI**	**%**	**95%CI**
Parental education				
High	24	18-30	30	24-37
Middle	25	22-28	29	26-32
Low	28	26-29	27	25-29
Parental occupation				
Non-manual	26	22-30	27	23-31
Manual	28	26-31	26	23-28
Childhood adversities				
Long-term financial problems				
Yes	28	25-31	28	25-32
No	26	25-28	27	25-29
Parental regular unemployment				
Yes	29	22-35	29	23-35
No	27	25-28	27	25-29
Parental serious illness or disability				
Yes	27	24-30	27	24-31
No	26	25-28	27	25-29
Parental alcohol problem				
Yes	46	29-63	29	11-46
No	27	25-28	27	25-29
Parental mental health problem				
Yes	26	25-28	29	8-51
No	27	11-41	27	25-29
Serious conflicts within family				
Yes	29	25-34	25	21-30
No	26	24-27	27	26-29
Parental divorce				
Yes	27	22-32	29	25-29
No	27	25-28	27	24-35
Own serious chronic disease				
Yes	33	26-40	31	25-29
No	26	25-28	27	24-38
Bullying at school				
Yes	30	25-28	31	26-36
No	26	25-35	27	25-28

TABLE 4 Continued

ADOLESCENCE SPORTS AND EXERCISE				
Opinions on physical education in childhood				
Physical education was interesting and pleasant				
I disagree	19	16-22	23	18-28
I somewhat agree	19	16-21	23	20-26
I entirely agree	23	20-26	25	22-26
I learned useful physical activity skills in physical education classes				
I disagree	20	17-23	25	20-30
I somewhat agree	19	16-22	23	20-26
I entirely agree	19	16-22	23	19-26
Participation on competitive sports in youth				
Running				
Yes	19	19-22	19	13-25
No	20	13-25	25	23-27
Cross-country skiing				
Yes	22	17-27	19	14-24
No	20	18-22	25	23-27
Track and field				
Yes	20	19-22	19	13-25
No	20	13-27	24	22-26
Exercise in late adolescence				
>5 times a week	16	12-19	23	18-27
4-5 times a week	15	12-18	18	14-21
2-3 times a week	19	16-22	22	19-25
Once a week or less	26	23-30	30	25-34

a: The outcome for childhood socioeconomic is from H2000: no physical activities whereas for adolescence sports and exercise the outcome is those who do fulfil the ACSM/AHA Recommendations for health-enhancing physical activity (Haskell et al. 2007 Circulation)

No consistent or statistically significant associations between parental education and parental occupation with adulthood LTPA were found (Table 4). However, women with low parental socioeconomic position slightly more often reported adulthood LTPI compared to those with high parental socioeconomic position. Childhood adversities showed inconsistent associations with adulthood LTPI. Many of the childhood adversities were associated with adulthood LTPI but only few of them reached statistical significance. Among women, parental alcohol problems were

associated with adulthood LTPI. Among men, the association between bullying at school and adulthood LTPI nearly reached statistical significance.

The associations of adolescence sports and exercise with adulthood LTPI were mainly inconsistent and statistically non-significant (Table 4). Those adults who reported that they had not learned useful skills in physical education classes were slightly less physically active during leisure-time than those who reported learning useful skills. Among men, there were some indications that those who had participated in running, cross-country skiing or track and field were more physically inactive during leisure-time compared to those who had not participated in these events in youth. Among women and men, those who had exercised only once a week or less in late adolescence participated less in LTPA in adulthood compared to those who were active exercisers in late adolescence.

TABLE 5 The examined adulthood determinants of adulthood leisure-time physical inactivity among Finns. Age-adjusted prevalence (%) and 95% confidence intervals (95%CI). (Unpublished work)

	Leisure-time physical inactivity (H2000: no physical activities)			
	WOMEN		**MEN**	
Family structure	**%**	**95%CI**	**%**	**95%CI**
Married/cohabiting and children	24	21-27	27	24-31
Married/cohabiting and no children	25	23-28	25	23-28
Single parent	32	24-41	15	5-25
Living with someone other than a partner	37	26-47	32	23-41
Living alone	29	24-34	30	25-36
Main economic activity				
Employed	25	22-28	27	24-29
Unemployed	24	19-28	24	18-30
Retiree	34	30-39	31	26-36
Housewife/-husband	26	18-35	58	9-100
HISTORY OF PHYSICAL WORKLOAD				
Physically strenuous work				
High	21	16-27	31	26-36
Low	23	21-25	25	22-28
Kneel or squat 1h/day				
High	21	16-26	33	28-37
Low	23	21-25	25	22-27
Drive a car, tractor or other work machine at least 4h/day				
High	22	16-28	31	26-67
Low	23	21-24	25	23-27
Manually move items heavier than 5 kg at least twice/min for at least 4h/day				
High	22	17-27	32	28-37
Low	23	20-25	25	22-27
Manually move items heavier than 20 kg at least 10 times / day				
High	19	14-25	32	27-36
Low	23	21-25	25	22-27

TABLE 5 Continued

Work with hands above the shoulder level at least 1h/day				
High	24	18-29	35	30-39
Low	22	20-24	24	22-27
Working in a forward leaning position without support at least 1h/day				
High	21	17-26	33	28-38
Low	23	21-25	25	22-27
Work demanding great handgrip strength at least 1h/day				
High	23	18-29	32	28-37
Low	22	20-24	25	22-27
Work with continuous movements of the hands or wrists				
High	24	19-28	33	28-37
Low	22	20-24	24	22-27
Work with a vibrating tool at least 2h/day				
High	22	18-26	31	25-36
Low	23	20-25	25	23-28
Work that requires standing or walking at least 5h/day				
High	25	18-31	35	30-40
Low	22	20-24	24	22-27
Current physically strenuous work				
High	24	20-27	29	25-32
Low	22	20-24	24	21-28
Current job strain				
Low demand, low control	25	22-29	30	25-35
High demand, low control	25	21-30	29	24-34
Low demand, high control	18	14-21	25	21-28
High demand, high control	22	18-26	24	21-28
Working hours per week				
Less than 38.5 h	22	20-24	24	20-27
More than 38.5 h	24	20-28	28	25-31
Work schedule				
Regular	22	20-24	27	24-29
Shift work	25	21-30	22	17-28
Diagnosed chronic diseases				
Cardiovascular disease				
Yes	24	19-30	27	24-28
No	22	20-24	26	21-33
Respiratory disease				
Yes	21	15-26	25	24-28
No	23	21-25	26	18-33
Musculoskeletal disease				
Yes	24	20-27	29	25-32
No	22	20-24	25	22-28
Body mass index				
Normal	23	21-25	24	21-27
Overweight	26	24-29	26	24-28
Obese	38	34-41	35	31-39
Smoking				
Nonsmoker	27	25-29	22	20-25
Former smoker	24	20-28	25	22-27
Occasional smoker	20	12-29	19	13-26
Daily smoker	37	33-41	39	36-43
Excessive alcohol consumption				
Less than risk limit	28	26-29	27	25-29
Higher than risk limit	36	30-41	35	30-40

In adulthood (Table 5), living with someone else than a partner was associated with LTPA; however, this only reached statistical significance among women. No statistically significant differences between main economic activity and LTPI were found.

Nearly all the exposures in the history of physical workload were associated with LTPI among men (Table 5). Among women, no statistically significant associations were found. Current physically strenuous work was not associated with LTPI. Those who reported high job strain participated less in LTPA compared to those with low job strain. Among men, working more than 38.5 hours per week was associated with LTPI whereas work schedule had no association with LTPI. Moreover, none of the diagnosed chronic diseases were associated with LTPI.

Participants who were obese, daily smokers or excessive alcohol users were more likely to participate in LTPI compared to contemporaries who were of a normal weigh, non-smokers or under the risk limit for alcohol use (Table 5).

7.2 Low Income Women and Men Remained Physically Inactive during Leisure-Time and while Commuting from 1978 to 2002 (Study I)

Among employed women and men, LTPA increased between 1978 and 2002 and CPA decreased (Figure 2). According to the trend-test, changes over the entire research period in LTPA and CPA were statistically significant among women and men (p-values<0.001). In addition, employed women were physically more active while commuting than employed men over the entire research period.

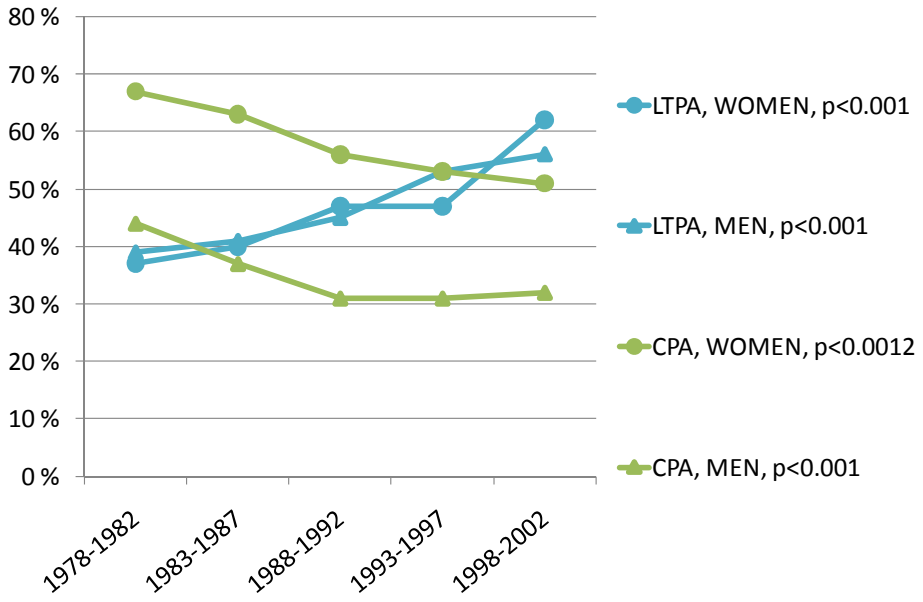

FIGURE 2 Trends in leisure-time physical activity (LTPA) and commuting physical activity (CPA) among employed Finns between 1978 and 2002. Age-adjusted prevalence (%) and p-values from the trend test over the whole study period.

Among men and women, those with low household income were more likely to be physically inactive during leisure time than those with high income between 1978 and 2002 (Figure 3). Moreover, those with low household income were more likely to be physically inactive while commuting across the whole research period (Figure 4). Manual worker women were more physically active while commuting than upper-level employee women (Figure 4). The educational differences in CPA and LTPA were mainly statistically non-significant in each research period among women and men (data not shown, see Study I).

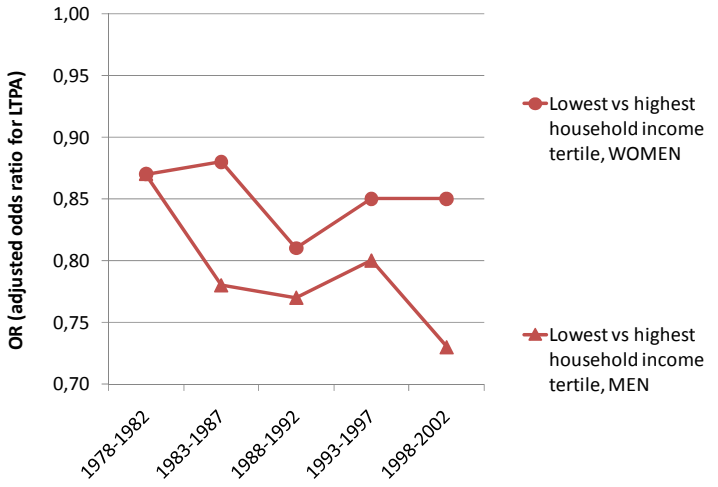

FIGURE 3 Leisure-time physical activity (LTPA) by household income among women and men between 1978 and 2002. Logistic regression, age and mutually adjusted odds ratios (OR) for leisure-time physical activity (LTPA) by study periods.

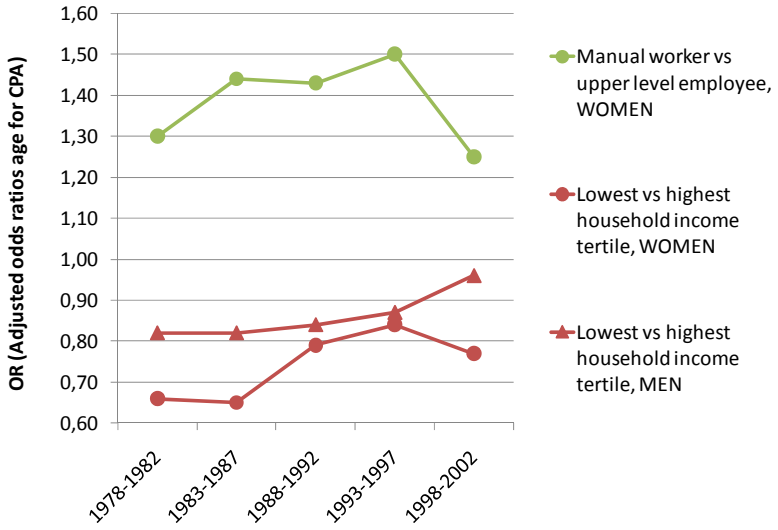

FIGURE 4 Commuting physical activity (CPA) by household income among women and men and by occupational class among women between 1978 and 2002. Logistic regression, age and mutually adjusted odds ratios (OR) for commuting physical activity (CPA) by study periods.

7.3 Childhood Socioeconomic Circumstances Contributed to Educational Differences in Leisure-time Physical Inactivity through Adulthood Socioeconomic Circumstances and Other Health Behaviours (Study II)

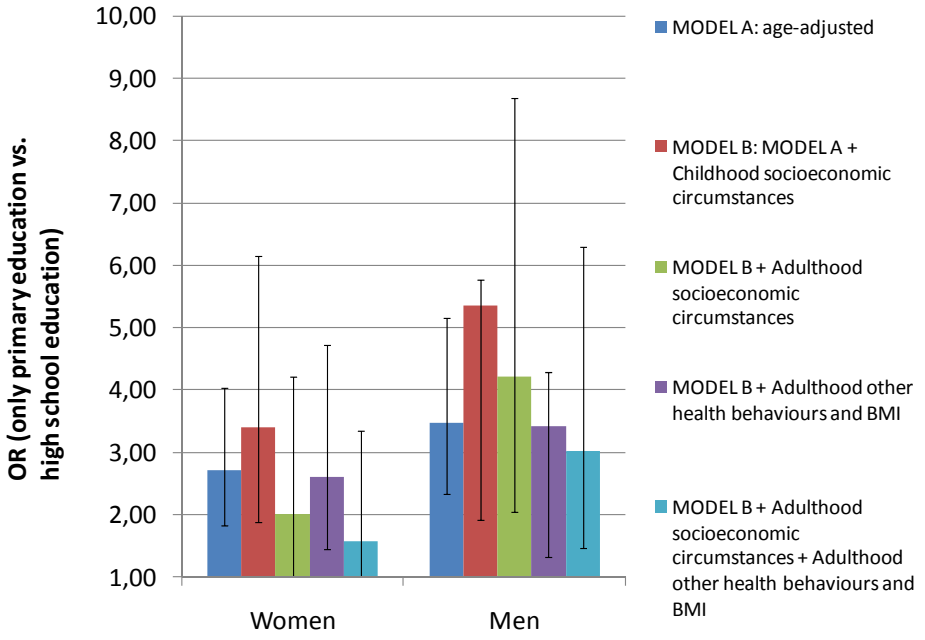

FIGURE 5 Educational differences in LTPI: the direct and indirect effect of childhood and adulthood socioeconomic circumstances, and adulthood other health behaviours and related factors. Sequential logistic regression, age-adjusted odds ratios (OR) for leisure-time physical inactivity (LTPI), and their 95% confidence intervals.

Childhood socioeconomic circumstances, mainly parental education and occupation, had a smaller direct effect on educational differences in LTPI among women than among men (Figure 5). The relative educational differences in LTPI were widened due to childhood socioeconomic circumstances. Among men, the indirect effect of childhood socioeconomic conditions on educational differences in LTPI was also substantial through adulthood socioeconomic conditions. Among women, the associations of childhood socioeconomic conditions to educational differences in LTPI were mainly similar, but mainly not statistically significant. The indirect effect of childhood socioeconomic conditions on adulthood LTPI through adulthood socioeconomic conditions was, therefore, very weak. In both genders, the indirect effect of childhood socioeconomic conditions on adulthood LTPI was notable

through other health behaviours in adulthood. Adulthood socioeconomic conditions had also a considerable indirect effect on educational differences in LTPI through other adulthood health behaviours among men.

7.4 Competitive Sports in Youth among Low Educated and Exercise in Adolescence among Highly Educated Predicted Adulthood Leisure-time Physical Activity (Study III)

Among the low educated, participation in competitive sports in youth had a direct effect on adulthood LTPA, while among the high educated, exercise in late adolescence had a direct effect on adulthood LTPA (Figure 6). Opinions on PE in childhood had a different indirect effect on adulthood LTPA depending on the direct effects. Among the low educated, the indirect effect of opinions on PE in childhood on adulthood LTPA went through participation in competitive sports whereas among the high educated the indirect effect went through exercise in late adolescence. The direct and indirect effects were mainly similar among both genders. More precise information about the measurement models and age-group analyses as well as fit indexes can be found in Study III.

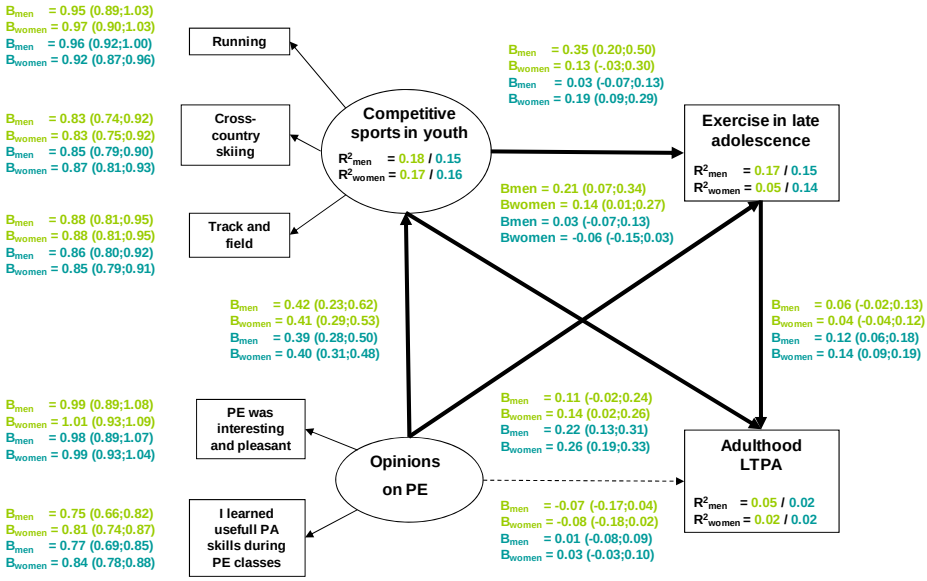

FIGURE 6 The direct and indirect effects of adolescence sports and exercise and opinions on PE on adulthood LTPA among low-educated (in green) and high-educated (in blue) women and among men. Structural equations modelling, standardised regression estimates (B), 95% confidence intervals (lower limit; upper limit) and squared residuals (R^2).

7.5 Long Exposure to Physically Strenuous Working Conditions in Men and High Job Strain in Women Contributed to Some Extent to Occupational Class Differences in Leisure-time Physical Inactivity (Study IV)

LTPI was more common among manual workers than among non-manual workers (Figure 7). In women, controlling for job strain somewhat decreased the occupational class differences in LTPI. In men, adjusting for history of physical workload after all other adjustments decreased the occupational class differences in LTPI substantially. Controlling for BMI and smoking decreased occupational class differences in LTPI among both genders.

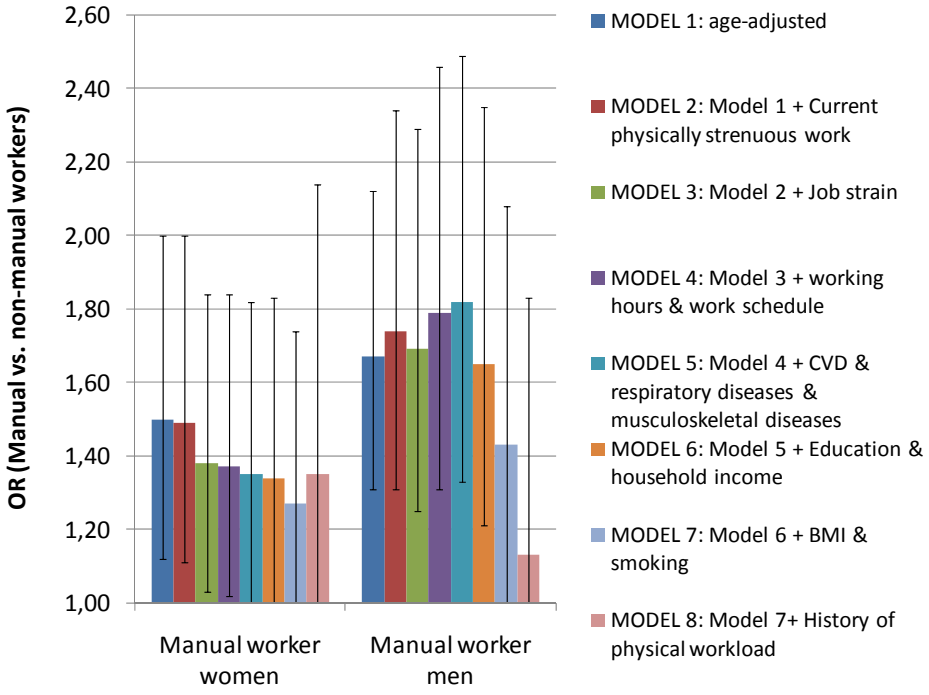

FIGURE 7 Occupational class differences in LTPI: the contribution of past and present workload as well as other work-related factors. Sequential logistic regression, age-adjusted odds ratios (OR) for leisure-time physical inactivity (LTPI), and their 95% confidence intervals.

8 Discussion

8.1 Trends and Explanations for Socioeconomic Differences in Physical Activity among Adult Finns

Socioeconomic differences in leisure-time and commuting physical activity among employed Finns have remained similar from 1978 to 2002. During these 25 years, those with low household income remained physically inactive both during leisure-time and while commuting. Manual worker women have, however, remained physically active while commuting compared to their other occupational class contemporaries.

Childhood socioeconomic position and adolescence sports and exercise explained educational differences in leisure-time physical activity among adults. Parental socioeconomic position had both direct and indirect pathways to educational differences in adulthood leisure-time physical activity either through adulthood socioeconomic position or other adulthood health behaviours. The pathways of physical activity from childhood to adulthood leisure-time physical activity were different depending on educational career. Participation in competitive sports in youth predicted adulthood leisure-time physical activity among the low-educated whereas exercise in late adolescence predicted adulthood leisure-time physical activity among the high-educated. Opinions on physical education in childhood had different indirect effects depending on educational career.

Accumulation of physically demanding working conditions in men and a high current job strain in women explained occupational class differences in leisure-time physical activity.

8.2 Socioeconomic trends in physical activity between 1978 and 2002

In the Weberian context, our assumption was that individuals have different chances (socioeconomic position, income, occupation) that determine the choices available for them (Abel, 1991, Abel et al., 2000, Cockerham et al., 1993, Cockerham et al., 1997, Osler et al., 2000). In this study, the examined choice was leisure-time or commuting physical activity. As generally populations have followed a decreasing trend in occupational and commuting physical activity but an increasing trend in leisure-time physical activity (Barengo et al., 2002, Borodulin et al., 2008a, Brownson et al., 2005, Simpson et al., 2003, Stamatakis et al., 2007, Borrell et al., 2000), one would assume that the choice of being physically active during leisure-time has become more popular and commuting physical activity more unpopular.

Our findings (Study I) are in agreement with this; physical activity during leisure-time has increased and physical activity while commuting has decreased among employed Finns when turning into the 21st century. The chances for being physically active might, however, not have been the same across socioeconomic groups. Although several studies have reported socioeconomic differences in physical activity (Kaleta and Jegier, 2007, Vaz de Almeida et al., 1999, Martinez-Gonzalez MA et al., 2001, Telama et al., 1997, Salmon et al., 2000, Kuh and Cooper, 1992, Aarnio et al., 2002a, Borodulin et al., 2008b, Haskell et al., 2007, Barnett et al., 2007, Craig et al., 2004, Simpson et al., 2003), there is a paucity of research on the development of socioeconomic differences in physical activity over time. It might be that some socioeconomic groups have dropped out from the increasing trend of leisure-time physical activity. Our results (Study I) suggest that those with low household income might not have equal chances for being physically active compared to those with high income. The low-income group remained physically inactive both during leisure-time and while commuting over the whole time period from 1978 to 2002.

A study from England (Stamatakis and Chaudhury, 2008) found that lower participation in sports and exercise was consistently more prominent among the low income than among high-income households between 1997 and 2006. However, emerging income differences in leisure-time physical activity have been reported in Canadians between 1981 and 2000 (Craig et al., 2004), while socioeconomic differences in leisure-time physical activity have narrowed in the Minneapolis area (Iribarren et al., 1997). In the latter study from Minneapolis, the groups who levels of income and education were low increased their leisure-time physical activity and were able to diminish the socioeconomic gap.

Engagement in physical activity might, also, be a question of choice regardless of the chances one has. Manual worker women were found to be physically active commuters over the whole time period from 1978 to 2002 (Study I). For the manual worker women, commuting physical activity might be a practical choice, i.e. they cannot afford private or public transport. It has been suggested that for women bicycling might also be a means for their own social and geographical independence (Kalanti, 2005), as men normally control the car. To our knowledge, very limited evidence exists on socioeconomic trends in commuting physical activity. One English study (Stamatakis and Chaudhury, 2008) found, albeit among non-manual men, an upward trend in overall participation in sports and exercise from 1997 to 2006. The participation in sports and exercise included all recreational walking and cycling and did not explicitly concentrate on commuting physical activity alone. Another study (Steffen et al., 2006) found that life-style physical activity, including commuting physical activity, slightly increased among employed and lower

educated men from 1980 to 2002. No other study has shown a commuting physical activity trend among manual worker women similar to the one found in our study.

All educational groups followed similar positive leisure-time physical activity trends from 1978 to 2002 (Study I). A population-based study of Finns living in Eastern Finland also concluded that education, compared to body mass index and occupation, had no contribution to socioeconomic differences in total physical activity after the year 1977 (Barengo et al., 2006b). Similar findings have also been reported among Danish adults (Osler et al., 2000), where all educational groups followed an increasing leisure-time physical activity trend. However, contradicting findings have been reported as well (Barnett et al., 2007, Smith et al., 2009, Petersen et al., 2010, Harper and Lynch, 2007): educational differences in leisure-time physical activity might have persisted or even increased among adults in Canada, the USA and Denmark when coming into the 21st century.

Results (Study I) suggest that occupation and income have relatively higher importance for socioeconomic trends in physical activity compared to education. Education can be thought to represent the health knowledge adopted during one's educational career whereas occupation relates to a need to rest after a physically or mentally exhausting work-day. Occupation might also represent the physical activity culture adopted from peers within the same socioeconomic group. It has been suggested (Gruneau, 1999) that those in a low socioeconomic group might value more amusement and undisciplined sports whereas those with high socioeconomic position value relaxing and representational structured sports and games. Compared to occupation, income might represent material resources such as the availability of money or sports equipment that enable participation in physical activity. It seems that cultural and material resources have influenced socioeconomic trends in leisure-time and commuting physical activity more than health knowledge. Age-cohort effect might also partly explain the choice of being physically active. Since the older age-cohorts had more physically demanding work and were more physically active while commuting compared to the younger age-cohorts, the older age-cohorts have also continued their physically active life-style during leisure-time (Borodulin et al., 2008a).

8.3 Pathways from Childhood Socioeconomic Circumstances and Adolescence Sports and Exercise to Adulthood Leisure-Time Physical Activity

Parental socioeconomic position might have several pathways to socioeconomic differences in leisure-time physical activity among adults (Study II). A strong direct pathway between parental socioeconomic position and adulthood socioeconomic differences in leisure-time physical activity was found. In addition, two indirect

pathways were found between parental socioeconomic position and adulthood socioeconomic differences in leisure-time physical activity. The indirect pathways went either through adulthood socioeconomic circumstances or through other adulthood health behaviours and body mass index. The indirect pathways were, however, weaker than the direct pathway. From the life course perspective, the two indirect pathways from poor childhood socioeconomic circumstances to socioeconomic differences in leisure-time physical activity can be interpreted as a chain of risks. The parental socioeconomic position has an independent effect on adulthood leisure-time physical activity but also leads to later poor exposures such as low adulthood socioeconomic position and other adulthood unhealthy behaviours. One could also see, in the Weberian sense, the accumulation of poor exposures as an accumulation of poor chances. The accumulation of poor chances might lead those with low socioeconomic position to make unhealthy choices such as excessive use of alcohol, poor diet or sedentariness.

To our knowledge, no previous studies have examined how childhood socioeconomic circumstances explain adulthood socioeconomic differences in leisure-time physical activity. Studies have, however, suggested that childhood socioeconomic circumstances affect adolescence and adulthood leisure-time physical activity (Barnekow-Bergkvist et al., 1998, Kuh and Cooper, 1992, Pietilä et al., 1995, Gorely et al., 2009, Kantomaa et al., 2007, Inchley et al., 2005, Lehto et al., 2009, Huurre et al., 2003, van de Mheen et al., 1998). Some studies have argued that parental socioeconomic position might not have an independent effect on adulthood leisure-time physical activity whereas the adulthood socioeconomic position would fully explain adulthood leisure-time physical activity (Blane et al., 1996, Kuh and Cooper, 1992, Wannamethee et al., 1996, Tammelin et al., 2003a). In addition, our results contradict those with a Danish study that did not find any effect between childhood socioeconomic conditions and later physical activity (Osler et al., 2008).

One explanation for our findings could be that parents with higher socioeconomic position give their children more financial and motivational support as well as encourage them to be physically active by their own example more than parents with lower socioeconomic position (Aarnio et al., 1997, Freedson and Evenson, 1991, Kantomaa et al., 2007, van de Mheen et al., 1998). Culture that endorses physical activity or a physically active lifestyle may be adopted in early childhood. Behaviours adopted in early life could be more stable until adulthood compared to behaviours, such as smoking and alcohol consumption, which are generally adopted later in the lifespan (van de Mheen et al., 1998). However, contradicting findings exist suggesting that parental physical activity does not foster children's physical activity (Perusse et al., 1988, Jago et al., 2010).

The pathways from adolescence sports and exercise to adulthood leisure-time physical activity might depend on the educational career (Study III). Our findings indicate that the adulthood leisure-time physical activity is predicted by participation in competitive sports in youth among those with low education and by exercise in late adolescence among those with high education. Although some studies (Ball et al., 2006, Burton et al., 2003, Wardle and Steptoe, 2003, Droomers et al., 1998) have examined whether determinants of physical activity vary across socioeconomic groups, to our knowledge no population-based studies have examined whether earlier physical activity history varies between low and high socioeconomic groups. One qualitative study found that negative experiences of physical activity in early life were consistently mentioned as barriers for physical activity among women with low socioeconomic position (Ball et al., 2006).

Several studies have shown that well-rounded participation in sports and exercise predicts later physical activity (Aarnio et al., 2002b, Engström, 2008, Kjonniksen et al., 2008, Tammelin et al., 2003b). Moreover, studies have suggested that membership in a sports club or association predicts physical activity in adulthood (Kjonniksen et al., 2009, Zick et al., 2007, Zimmermann-Sloutskis et al., 2010). One study has also suggested that those with high socioeconomic position are more likely to increase their physical activity during their transition from childhood to adulthood (Cleland et al., 2009). Based on the results (Study III), there may be some sociocultural differences in physical activity between those with low and high socioeconomic position. Those with low socioeconomic position can value physical activities that are associated with team spirit, excitement and amusement or they try to achieve non-academic success. Those with high socioeconomic position might consider health benefits when choosing physical activities.

Opinions on physical education in childhood did not have direct but rather indirect pathways to adulthood leisure-time physical activity (Study III). Among those with low socioeconomic position, opinions on physical education had an indirect pathway to adulthood total leisure-time physical activity through participation in competitive sports in youth. Among those with high socioeconomic position, the indirect pathway went through exercise in late adolescence. Several studies have shown that participation in physical education or school sport clubs and high grades in physical education predict later physical activity (Glenmark et al., 1994, Kuh and Cooper, 1992, Nelson et al., 2005, Tammelin et al., 2003a). Moreover, physically active students are higher achievers in their educational career (Aarnio et al., 2002a, Kuh and Cooper, 1992). Previous literature shows that enjoyment and motivation of physical education can affect childhood and adolescence physical activity patterns (Cox et al., 2008, Lonsdale et al., 2009, Sallis et al., 1999). Our results suggest that

the effect of motivation and enjoyment of physical education in childhood might be seen much later, even in increased participation in adulthood physical activity.

8.4 Adulthood Leisure-time Physical Activity and the Accumulation of Physically Demanding Workload and Current Job Strain

The accumulation of physically demanding workload during the life span explains adulthood occupational class differences in leisure-time physical inactivity among men (Study IV). Our results contradict the findings of a study where the effect of five-year accumulation of passive jobs encouraged men in particular to be more physically inactive during leisure-time (Gimeno et al., 2009). The results disagree with a study that found low occupational physical activity to be associated with low leisure-time physical activity (Holtermann et al., 2009) but agrees with a study where socioeconomic differences in leisure-time physical activity diminished after taking into account occupational physical activity among men (Salmon et al., 2000). Some studies have, however, suggested that those with high occupational physical activity are also physically active during leisure-time (Parsons et al., 2009, Wolin and Bennett, 2008, Wu and Porell, 2000). One explanation for the inconsistency between our results and other studies could be the different methods used to measure occupational and leisure-time physical activity.

High current job strain explained, to some extent, the occupational class differences in leisure-time physical inactivity among women (Study IV). Similar findings have been found in some studies where those experiencing high job strain were less likely to participate in leisure-time physical activity (Ali and Lindström, 2006, Kouvonen et al., 2005). Contradictory findings have also been found where job strain did not explain socioeconomic differences in leisure-time physical activity or did not even associate with leisure-time physical activity (Lallukka et al., 2008, Lallukka et al., 2004, Lahelma et al., 2010, Wemme and Rosvall, 2005).

General lack of time has been suggested to be a barrier for leisure-time physical activity (Booth et al., 1997, Thomas et al., 2004). In our study, long working hours and work schedule did not explain socioeconomic differences in leisure-time physical activity (Study IV). Several studies have suggested otherwise; one's possibility to control one's own work, such as in terms of working hours and influencing work demands, might determine leisure-time physical activity (Hellerstedt and Jeffery, 1997, Popham and Mitchell, 2006, Schneider and Becker, 2005). Contradicting findings have also been reported where working hours did not contribute to leisure-time physical activity (Burton and Turrell, 2000, Parsons et al., 2009).

There could be several explanations for the effect of working conditions on socioeconomic differences in leisure-time physical activity. The most likely one is that there exist several mechanisms through which working conditions could affect leisure-time physical activity. From the life course perspective, exposure to several detrimental conditions might lead to unhealthy behaviours. In this study, long exposure to physically demanding working conditions during the lifespan or exposure to several current mentally strenuous working conditions were seen to lead to physical inactivity during leisure-time. In our study (Study IV), men with low socioeconomic position worked mostly in metal and wood crafting, construction, and related jobs. Having a long exposure to such physically strenuous working conditions may cause men to make the choice of being physically inactive to recover from the demands of physical work. Women with low socioeconomic position worked in cleaning, cooking, laundering and related jobs. These jobs are not only physically strenuous but may offer few chances to influence one's own work, which may diminish motivation for being physically active during leisure time.

The so-called "healthy worker effect" could also be an explanation for the association between physically demanding working history and leisure-time physical inactivity. Those with poor health are more likely to drop into the lower end of socioeconomic strata whereas those with better health are more likely to be in the top socioeconomic strata. Although health limitations have been consistently more often reported as a barrier to leisure-time physical activity among those with low socioeconomic position (Burton et al., 2003, Chinn et al., 1999), our results did not support this.

8.5 Methodological Considerations

When interpreting the results of this study, several methodological aspects should be kept in mind. Firstly, the cross-sectional study design limits causal interpretation, yet the temporal order of childhood socioeconomic circumstances and adolescence sports and exercise as well as adulthood socioeconomic circumstances and health behaviours can be assumed with retrospective information. The available datasets limits appliance of a true life-course analysis. Ideally when applying life-course perspective, one should follow the same persons over the whole life-span with a longitudinal design. The longitudinal design provides an accurate information about the time and duration of the exposure as well as about the intra-personal variation over time (Kuh and Ben-Shlomo, 2004a). When a long intervening period exist between childhoods socioeconomic circumstances and adulthood physical activity, there might be a third unknown confounding factor, which explains the association between parental socioeconomic position and adulthood physical activity or the association could also be due to the difference in the measurement (Kuh and Ben-Shlomo, 2004a). In this study, we did not have information available from the

possible exposures to detrimental conditions during all the life-phases between childhood and adulthood. Multivariate methods, however, enable us to limit many potential confounding factors. Therefore, the long intervening period was unlikely to produce in huge bias in our results. Measurement error would not affect remarkably on our results, since socioeconomic position in childhood and adulthood was mainly measured with similar questions.

Secondly, the retrospective information might have been influenced by recall bias and the participants' current perceptions (negative affectivity) might influence how they remember their childhood and adolescence (Lissner et al., 2004, Sallis and Owen, 1999b, Pettee et al., 2009). For example, it could be that respondents who are physically active in adulthood might recall and report more favourable attitudes toward physical education in childhood or toward childhood socioeconomic circumstances. The varying recall time in retrospective questions between the respondents from the younger and the older birth cohorts might have influenced their answers. The younger respondents might remember their physical activity history more accurately compared to the older respondents. The retrospective information can, however, be seen as sufficiently valid and reliable but should always be interpreted with caution (Dube et al., 2004, Hardt and Rutter, 2004, Widom et al., 2004, Kendall-Tackett and Becker-Blease, 2004, Berney and Blane, 1997). Estimation of physical activity history is challenging, since many events such as physical activity experiences and changes of motives might have happened during the recall time which may affect perceptions of childhood and adolescence physical activity. (Taylor et al., 1999, Winters-Hart et al., 2004) Although we cannot be certain of the effect size of the recall bias and negative affectivity on our results, we may assume that negative early experiences (socioeconomic circumstances or physical activity) could have had a greater influence on adulthood physical activity among those respondents who were physically inactive in adulthood (negative causality) compared to those who were physically active.

Thirdly, physical activity was based on self-reported information. Self-reported measures of physical activity are a common way to assess physical activity in large populations and have good reliability and validity among adults. Self-reports of physical activity are known to be influenced by a recall bias, where the average recall bias has been estimated to be a half a unit on a four-point scale (Lissner et al., 2004). Self-reported physical activity is very close to objectively measured among adults whereas adolescents tend to overestimate their physical activity. No gender or socioeconomic differences have been found between self-reported and objectively measured physical activity among adults. (Sallis and Owen, 1999b, Pettee et al., 2009, Slootmaker et al., 2009) Although not all of our adulthood physical activity measures correspond to the latest recommendations for health-enhancing physical

activity, they are sufficient for capturing those respondents who are insufficiently physically active for health benefits (Barengo et al., 2006a, Hu G et al., 2005, Laaksonen et al., 2008). Moreover, the same adulthood physical activity measures has also worked very consistently in several other studies (Barengo et al., 2006b, Borodulin et al., 2008a, Prättälä and Paalanen, 2007, Hu et al., 2010, Laaksonen et al., 2008). In addition, if we had been able to measure physical activity according to the latest physical activity recommendations, the prevalence of those categorised as physically inactive would probably have been nearly the same.

Fourthly, the Finnish school system has been different for the older and younger age-cohorts. Generally, the younger age-cohort has gained a higher educational level compared to the older age-cohorts. Some of the older age-cohorts were not able to attend senior high school due to poor living conditions and long distances in the post-war 1940s. In addition, one must remember that physical education in childhood was quite different among respondents from older birth cohorts than among respondents from younger birth cohorts. The effect of high socioeconomic position as well as childhood socioeconomic circumstances might have been stronger among the older age-cohorts than among the younger age-cohorts. Regarding physical education, we can assume that the younger age-cohort have had more motivating and enjoyable physical education as well as more possibilities to engage in physical activities during physical education classes compared to the older age-cohorts. We could, therefore, assume that for the older-age cohorts the effect of opinions of physical education on adulthood physical activity would have been stronger compared to the younger age-cohorts. However, no confirmation for this was found based on our age-specific analyses. Moreover, no age-group differences for the effects of other adolescence sports and exercise on adulthood physical activity were found.

Fifthly, non-response might have biased our results. In the socioeconomic trend analysis (Study I), our results may have been affected by the declining response rate. According to non-response analyses from the Health Behaviour and Health among the Finnish Adult Population Study (Tolonen et al., 2006), non-respondents were more likely to be young, low-educated and males. In the Health 2000 Survey (Heistaro, 2008), the non-respondents, which included younger men, individuals at both ends of the educational distribution, unemployed persons, those on low income, those living in the capital area, and those with an unknown family or socioeconomic position, were partly corrected using post-stratification weights in the analyses. In the National FINRISK Study (National Institute for Health and Welfare, 2002), the non-respondents in the original population sample were more likely to be young and low-educated whereas in the physical activity sub-study they were men, old, low-educated, and physically inactive during their leisure-time. Based on this, the

socioeconomic differences in leisure-time physical activity would be even wider in all of the datasets if non-respondents could be taken into account.

Finally, the use of several datasets can be seen as a strength, since they all provided diverse information on childhood and adolescence relevant for examining adulthood socioeconomic differences in physical activity. The Health Behaviour and Health among the Finnish Adult Population Study provided an annually repeated and nationally representative cross-sectional dataset to examine 25-year socioeconomic trends in leisure time and commuting physical activity. In the Health 2000 Survey, a clear strength was the high response rate (nearly 90%), which enabled the generalisation of our results to the Finnish population. The Health 2000 Study also included extensive information about childhood socioeconomic circumstances whereas the National FINRISK Study provided information on adolescence sports and exercise.

Several socioeconomic indicators were linked to the Health Behaviour and Health among the Finnish Adult Population Study and to the Health 2000 Survey from the national population registers. The validity of the measurements of socioeconomic data should also be discussed. All the self-reported indicators were compared against to register information from population registers. The register information of education and occupation were classified based on the guidelines of the Statistics Finland (Statistics Finland, 1997a, Statistics Finland, 1997b). Although the self-reported socioeconomic indicators included more missing information, they were consistent with the register-based socioeconomic indicators. The rationale for using different definitions for socioeconomic indicators in the studies was mainly practical and an ongoing process during this study. In the Studies I and II, we applied the register information of last taken education degree whereas in the Study III the years of full-time education was used. In the Study III, no register information of the education was available. Although the definitions of education where somewhat different, the basic association between education and physical activity were similar in all the studies. The main focus in this PhD study was on those individuals who belonged into the lower end of educational strata and where more likely to be physically inactive. There might have been some variation between the individuals who were categorised in low-educated group. However, we can assume that with large population-based datasets this would have only a minor effect on our results. In the Study IV, we used occupational class as an indicator of socioeconomic position. Occupation is most often determined by education and occupation was a more logical choice for a socioeconomic indicator when we were interested to examine the explanation of working conditions on socioeconomic differences in physical inactivity. Household income was based on register information and used as an indicator of socioeconomic position in study I. In Studies II and IV, household

income was only adjusted as a potential intervening factor. The definition of household income was, however, the same in all of the studies. It would have been interesting to examine the explanations for income differences in physical activity, this deserves further examination.

9 Conclusions and Implications

To conclude, the educational career plays a significant role in adopting a life-long physically active way of life and creating socioeconomic differences in physical activity among adult Finns. Although occupational status and household income were relatively more important in determining the physical activity trend than educational level, education still showed to be the strongest determinant of leisure-time physical activity. Moreover, educational career often affects people's occupational status and working career, which determines the working conditions people are daily exposed to. Educational career might also predict what kinds of physical activity habits people adopt during their lifespan. The influence of parental education might determine what kind of early experiences of physical activity in childhood people live through. It might be that educational career and physical activity are closely intertwined: educational career may influence people's choices for engaging physical activity, and physical activity may have a positive effect on learning and on educational career. One should not forget also the accumulation of unhealthy behaviours, which in this study were important determinants for being physically inactive in adulthood, especially among those with low socioeconomic position.

In recent years, several policy programmes targeting socioeconomic differences in physical activity have been implemented in Finland (Tolonen et al., 2010, Fogelholm et al., 2007, OPM, 2009, STM, 2008b, STM, 2008a). The main messages have been to guarantee healthy lifestyles for all, especially to those in the lowest socioeconomic position and to provide everyone equal possibilities and skills as well as means to be physically active. Generally the suggested measures to promote physical activity have included acquiring sufficient physical activity skills, embracing and maintaining a life-long physically active lifestyle, and having school, work and living environments that encourage physical activity. In addition, several policy measures have suggested that more funding should be provided for organising physical activity opportunities for all regardless of age, income or other limitations such as poor health or earlier sedentariness. This means that local authorities should play a more prominent role in promoting physical activity among their citizens. Moreover, schools are crucial in promoting physical activity among children and adolescents. Schools can support physically active life-style and provide physical activity opportunities for all individuals regardless of their socioeconomic background.

Mainly agreeing with the policy programmes, this study implies that we should support equal accessibility to physical activity facilities across socioeconomic strata. Promotion of physical activity should be taken more seriously in typical workplaces of low socioeconomic groups. Moreover, we should concentrate on creating childhood socioeconomic environments that motivate everyone equally to adopt a physically active life-style. Especially, children from families with a low socioeconomic background should be supported so that they too can have an equal opportunity to adopt life-long physically active life-styles. More emphasis should be paid to the clustering of unhealthy behaviours in adulthood, which is more common among those with low socioeconomic position. However, it has not been recognised by the Finnish policy programmes that the promotion of physical activity might be more effective if targeted according to socioeconomic position. Promotion of various kinds of sports and exercise in adolescence and in youth among those with low socioeconomic position might be a good way to narrow adulthood socioeconomic differences in physical activity.

Future studies should focus more on how socioeconomic differences in physical activity are developed during childhood and adolescence and indentifying their possible determinants. Adolescence is the critical period of the life course, when one seems to adopt a physically active life-style. The important turning points of the life course such as young adulthood, moving into the work force and having children and their effects on physical activity should also be investigated more in future. Moreover, it would also be interesting to know whether the socioeconomic differences in leisure-time physical activity also predict later socioeconomic differences in morbidity, early retirement, hospitalisation or mortality.

In the end, the applied life course perspective on socioeconomic differences in physical activity worked fairly well but yielded only few new insights. Childhood socioeconomic circumstances and adolescence sports and exercise explained only a small part of adulthood socioeconomic differences in physical activity. However, the life course perspective illustrated that the developing mechanisms of socioeconomic differences in physical activity might be very complex. Moreover, this study cannot provide a full answer to the question of which is more important, the chances or the choices for being physically active. For some, the choice of being physically active is made regardless of chances and vice versa. What truly might be important for making the choice of being physically active and promoting physical activity across socioeconomic groups is providing all individuals with the opportunities to enjoy and have positive social experiences from physical activity regardless of their backgrounds.

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