Young today-adult tomorrow! Studies on physical status, physical activity, attitudes, and self-perception in children and adolescents

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Young today – adult tomorrow!

Studies on physical status, physical activity, attitudes, and self-perception in children and adolescents

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Abstract

The aim was to gain knowledge of young people's physical status and physical activity, and to further the understanding of the role of school physical education in a salutogenic public health perspective. Two studies were performed in southern Sweden. Study 1 was performed in 1996 among 301 adolescents aged 16–19 in upper secondary school. It comprised three parts: a questionnaire, seven physical tests, anthropometrical measures and information on every student's grades. Study 2, with a longitudinal design and annual measurements, was performed in 2000–2003 (n=205–275) among children aged 6–12 in two primary schools, one intervention school with expanded physical education lessons, and one norm school which followed the stipulated curricular time. The study comprised a questionnaire, eleven physical tests and anthropometrical measures.

In Study 1, students in practical education for occupations such as industrial and building workers, mechanics, assistant nurses and hairdressers, all of which are occupations involving physical effort, had lower physical capacity than students in theoretical education among both boys and girls. A correlation was found between physical capacity and grades. An interrelation between Sense of Coherence (SOC) and attitudes to physical education was found, indicating that past experiences of physical activity and physical education could contribute to the development of SOC, and actual levels of SOC could influence the persistent attitudes to physical education and be important for lifelong physical activity.

Study 2 showed high self-perceived competence in physical education among children to be associated with high physical performance, male gender, low age, living with both parents, high self-perceived physical fitness and enjoying physical education. Children who followed an expanded physical education programme during the three-year follow-up showed positive changes in physical performance compared to children in the norm school. The number of children with increasing body mass index (BMI) rose in both schools, but a lower increase in BMI could be seen in the intervention school. In both Study 1 and 2, the highest physical capacity was found among children and adolescents who reported a high level of physical activity in leisure time.

This thesis shows it is possible to achieve improvement in physical status among young people with an increase of physical education lessons in school. Differences in physical capacity between prospective blue-collar and white-collar workers already in adolescence during education emphasize the need for early interventions to increase physical activity and capacity in young people. Physical education in the school setting could be seen as an important arena for improving physical capacity, positive self-perceptions and positive attitudes to physical activity, which could be important for public health.

Key words: Young people, children, adolescents, physical activity, physical education, physical status, physical capacity, self-perception, attitudes, sense of coherence, intervention.

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Discoveries are the results of methodical fumbling
Karl Friedrich Gauss

List of publications

This thesis is based on the following publications, referred to in the text by their Roman numerals:

I Sollerhed A-C., Ejlertsson G. Low physical capacity among adolescents in practical education. *Scandinavian Journal of Medicine and Science in Sports* 1999; 9: 249–256.

II Sollerhed A-C., Ejlertsson G., Apitzsch E. Predictors of strong sense of coherence and positive attitudes to physical education. *Scandinavian Journal of Public Health* 2005; 33: 334–342.

III Sollerhed A-C., Apitzsch E., Råstam L., Ejlertsson G. Factors associated with young children's self-perceived physical competence and self-reported physical activity. (Submitted).

IV Sollerhed A-C., Ejlertsson G. Benefits of expanded physical education in primary school: findings from a three-year intervention study in Sweden. (Submitted).

Abbreviations

ANOVA	Analysis of Variance
BMI	Body Mass Index
CI	Confidence Interval
LU	Lund University
N	Nominal
Num	Numerical
O	Ordinal
OR	Odds Ratio
PA	Physical Activity
PE	Physical Education
POR	Positive Odds Ratio
SOC	Sense of Coherence
SPSS	Statistical Package for the Social Sciences
VO_2	Volume of Oxygen

Contents

Preface

The question why some people like to be physically active and why some dislike it fascinates me. I belong to the group who like it – or rather love it. I have always loved to be physically active. I remember how I felt when I ran as fast as I could and climbed up the trees as high as I could in childhood. I liked it so much that it became my profession – a teacher of physical education. I wanted to teach other people how to appreciate physical activity, how to find the amazing feeling when moving. Having seen thousands of pupils and students passing by, the question why some people like physical activity and some do not has been reinforced. When I got the opportunity to perform a research project, the choice was easy: physical activity and physical capacity among adolescents and children. I still do not have an ultimate answer to the question about like or dislike, but I hope I can contribute a piece of the puzzle to further the understanding of physical activity in young people. This thesis might be valuable in the debate about the role of school physical education as an arena for public health.

The approach in this thesis has been interdisciplinary, from the angles of both the natural sciences and the human sciences. In short, this thesis is a mix of many topics. The focus has been on the aspects and consequences of physical activity for health among young people. I wanted the approach to be salutogenic, to concentrate on the positive factors for a healthy life, and not so much on the negative factors for an unhealthy life. However, traditional biomedical research has a more pathogenic view, and many of the references I used in this work were in this field. Thus the thesis has both the salutogenic and pathogenic approach, which could be seen as logical, since in the continuum between salutogenesis and pathogenesis there must somewhere be a place where the two meet.

The view of body and soul, psyche–soma, is an underlying idea, but is not discussed. However, during the performance of the studies and the analysis of the results, many opportunities have emerged to think about the philosophical psyche–soma discussion, but space does not permit extensive exposition and this must be left for another essay.

Children become adolescents, adolescents become adults, and adults have children who become adolescents who become adults who have children, and so on … Life goes on, with intergenerational links!

Children have never been good at listening to the adults, but they have never missed an opportunity to imitate them
James Baldwin

Definitions of frequently used terms

Young people: the term refers to school-aged boys and girls, in this thesis mainly denoting children and adolescents from 5 to 19 years old.

Adolescents: young people aged 11–21 years; in the study performed it denotes young people aged 16–19.

Young children / children: individuals younger than 11 years; in the study performed it denotes children aged 6–12.

Health: the word health is used several times in this work, but the aim of the thesis was not to discuss it from every point of view. Several definitions and theories about health have been presented over the years. WHO defined it as a resource for everyday living, not just the absence of disease. Young people's health is considered as a positive concept encompassing physical, social, and emotional well-being (WHO, 2000).

Physical activity: is a complex set of behaviour that encompasses any bodily movement produced by contraction of skeletal muscles that substantially increases energy expenditure (Caspersen et al, 1985).

Moderate intensity physical activity: for young people activity requiring 3–6 times as much energy as the resting level; equivalent to brisk walking.

Vigorous intensity physical activity: for young people activity requiring 7 times or more energy as resting level; equivalent to running.

Exercise is a subset of physical activity defined as planned, structured, and repetitive bodily movement done to improve or maintain one or more components of physical fitness (Caspersen et al, 1985).

Physical fitness is defined as a set of attributes that people have or achieve which relates to the ability to perform physical activity (Caspersen et al, 1985). The term physical fitness has been used differently in the research literature. Sometimes it is employed as an umbrella which captures both the variety of components that are assessed as motor and/or health-related fitness and the different motor abilities (endurance, agility, strength, power, flexibility, coordination) which need to be maintained or developed by physical activity and exercise. It has also been used synonymously with aerobic fitness.

Physical capacity is the ability to perform physical activity. Sometimes the term is used interchangeably with physical fitness.

Physical status: an overall picture of the individual's physical capacity and body dimensions.

Body Mass Index (BMI) was calculated as body weight in kilograms divided by body height in metres squared (kg/m^2).

Lifestyle: a complex concept which includes the entirety of norms and values as well as patterns of physical, social, and mental behaviour of an individual, varying with age, gender and cultural background.

Sense of Coherence (SOC): a personal orientation that expresses the way the individual responds to stress in life. SOC contains the sub-components manageability, comprehensibility and meaningfulness (Antonovsky, 1987).

Introduction

The problem in focus

Not only adults are physically inactive to a high extent. Many children and adolescents have also adopted a sedentary lifestyle. According to the World Health Organisation (WHO), less than one-third of young people are sufficiently physically active to benefit their present and future health (WHO, 1999). This summary by the World Health Organisation may well understate the problem with the increasing amount of sedentary people even among very young children. Studies indicate that many children do not achieve the lowest level of recommended daily physical activity of at least moderate intensity (Horgan, 2005). There is a discernible feeling that children, and adolescents in particular, are less active and fit today than in the past, and there is a public perception of an increasingly sedentary way of life among children (Blair, 1992; Corbin & Pangrazi, 1992). This perception has prompted concerns about the impact of these declining levels of physical activity and fitness on present and future health status of children.

Physical activity and physical fitness have been linked with health and longevity since ancient times. Modern epidemiological research documents the health hazards of sedentary behaviour. For example, inactive and unfit individuals are much more likely to develop cardiovascular diseases, diabetes type II, some cancers, osteoporosis and obesity (Blair et al, 1992). The scientific consensus is that physical inactivity bears much of the responsibility for the pandemic of obesity, with following obesity-related illness. Physical inactivity could be seen as a major public health problem that will continue to increase. Young physically inactive people are at risk of remaining inactive as adults, who unconsciously may be at risk of influencing and socializing their children to become inactive. Intergenerational amplifications of obesity may be underway, so the public health implications of obesity are immense (James, 1996).

Physical activity

Activity is defined as the state of being active; the exertion of energy, action (The Oxford English Dictionary, 1989), and is derived from the Latin word “agere”, which means to do. Activity and occupation is often used interchangeably, but occupation has been seen as a more appropriate word to use for all types of activity. Occupation provides the mechanism for people to fulfil basic human needs essential for survival. As human beings are occupational beings, occupations are impor-

tant to adapt to environmental changes, and to develop and exercise genetic capacities in order to maintain health. Humans engage in occupation, with individuality of purpose; they think about the effects, conceptualize, and plan before undertaking activity and they are able to reflect and mentally alter future behaviour as a result of outcomes (Wilcock, 1998). Physical activity is the underlying theme in this thesis and the activity concept according to Caspersen et al, (1985) has been used.

The distinction between physical activity and exercise is not always clear and there is an overlap between the constructs. Both terms are used in the following text, and sometimes there are occasions where these terms are used more loosely. In the Swedish language it is even more complicated as two different words for exercise are commonly used (*motion*, *träning*). In the studies performed here, both words were used in the questionnaires in different questions. The correlation between the answers to the different questions with the two words was very high.

It should not be forgotten that physical activity is our evolutionary heritage. In our history, people were physically active in order to survive. From the point of view of our biological heritage, in our current lifestyles we do not live according to our natural way of life. We were designed for physical activity, but today we live in an environment in which the opportunities to be physically active are quickly disappearing. We adapted to a lifestyle as hunter-gatherers and the evolutionary changes in our genetic code made it possible to survive. Major adaptations for this survival were habitual physical activity including both endurance and peak efforts alternating with rest (Åstrand, 1994). During the Neolithic, human health and lifestyle changed (Papathanasiou, 2005). Today physical activity has declined to a minimum and most people live their lives sitting. They undertake physical activity at will rather than for necessity. A great deal of the physical activity necessary for health must be freely chosen in leisure time or consciously integrated into one's normal daily routine. Very few people would run or walk for several hours every day as early humans did (Hetzel & McMichael, 1987). Many people live their daily life with an activity level close to the resting level. Physical activity in past met many other occupational needs and societal values. The modern view can be contrasted with the holistic nature of hunter-gatherer lifestyles in which physical activity and nutrition were part of an ecological healthy whole (King-Boyes, 1977).

Physical activity and health

People of all ages benefit from regular physical activity. Health benefits can be obtained by a moderate amount of physical activity, but additional health benefits can be gained through greater amounts of physical activity (US Department of Health and Human Services, 1996). The physiological outcomes that have special relevance during youth are aerobic fitness, bone mass and adiposity (Sallis & Owen, 1999). The development of motor skills in childhood is essential and could

be seen as an important part of human existence, both for the ability to perform physical activity and for self-esteem (Schmidt & Wrisberg, 2000).

Physical activity has been shown to have beneficial effects on mental health. Exercise was shown to improve mood and well-being and to reduce anxiety, depression, and stress. Exercise competes with negative affects, such as anxiety and depression in the somatic and cognitive systems, and could be seen as a form of meditation that triggers an altered and more relaxed state of consciousness. It was also found to have positive effects on self-concept, self-esteem, and self-assurance (Plante & Rodin, 1990). Besides the general effects on mental well-being, it also had positive effects as a therapeutic remedy on mental diseases. Several randomized controlled trials (RCTs) produced evidence for a positive effect of exercise on patients suffering from depression (Glenister, 1996). Both biological mechanisms and psychological processes underlie the connection between physical activity and mental health. Examples of biological mechanisms that are suggested to be involved are the increase in temperature, the increase in adrenal activity, enhanced neurotransmission of norepinephrine, serotonin, and dopamine, leading to improved mood. Exercise also leads to the release of endogenous morphine-like chemicals leading to enhanced feelings of well-being. Improved physical fitness provides people with a sense of mastery, control, and self-sufficiency, which is an example of psychological processes which are suggested to explain the connection between exercise and mental health. Exercise provides distraction, diversion, time out from unpleasant cognitions, emotions, and behaviour. Exercise is a form of biofeedback that teaches exercisers to regulate their own autonomic arousal, and could therefore be seen as a buffer, resulting in decreased strain caused by stressful events in life (Plante & Rodin, 1990).

Fitness levels affect the experiences of physical activity. Trained participants reported greater positive effects after high intensity exercise in comparison with untrained participants (Boutcher et al, 1997; Hardy & Rejeski, 1989) and feeling states in exercise were shown to be worse at higher exercise intensity for less active individuals (Moses et al, 1989; Steptoe & Bolton, 1988; Leith, 1994). The increases in negative mood after high intensity exercise may be due to the higher exertion required (Steptoe & Bolton, 1988; Boutcher et al, 1997). Training status is suggested to account for post-exercise affective responses (Hardy & Rejeski, 1989). Moderate-intensity exercise seems to have the best impact on participant mood states in general (Moses et al, 1989).

Physical capacity and fitness

Physical fitness is the set of attributes that people have or achieve from physical activity, and the attributes that relate to the ability to perform physical activity. It has been suggested that physical fitness is more appropriate and objective to investigate

than physical activity. Health-related outcomes are often compared between groups differing in their levels of physical activity and/or fitness. Most researchers have studied physical activity because of low costs. Assessing physical fitness is combined with both practical and economic difficulties. Physical fitness is related both to current physical activity levels and to a function of heredity (Morrow & Freedson, 1994). The genes cannot alone be responsible for high fitness. The sentence "use it or lose it" is applicable here.

It is usual to refer to health-related and performance-related components of physical fitness (Caspersen et al, 1985). The performance-related aspects of fitness are associated with athletic ability. The components include agility, balance, coordination, power, reaction time, and speed. Health-related fitness has been defined as the attainment or maintenance of physical capacities that are related to good or improved health and are necessary for performing daily activities and confronting expected or unexpected physical challenges (Morrow et al, 2000). The health-related components of physical fitness have traditionally been defined as cardiovascular fitness, muscular strength and endurance, muscle flexibility, and body composition (Caspersen et al, 1985). In this thesis the physical tests in the studies among children and adolescents contain components of both performance-related and health-related fitness.

Childhood physical activity

Among young children habitual physical activity is characterized by an intermittent pattern (Sallo & Silla, 1997). Studies with daily heart rate monitoring showed that individuals who spent longer periods of time with higher heart rate were generally more active than those children whose heart rates were lower (Bar-Or, 1983; Freedson & Miller, 2000; Sallis et al, 1990). Exercise capacity and maximal oxygen uptake increase throughout childhood, due to normal growth. Children have been shown to be physiologically adaptive to endurance exercise (Roberts, 2000). Regular physical activity is generally viewed as having a favourable influence on the growth, biological maturation, and physical fitness of children and adolescents (Bailey et al, 1995; Malina, 1994; Malina, 1996; Malina, 2001; Baranowski et al, 1992; Bouchard & Shephard, 1994). An adequately functioning musculoskeletal system is important for functional capacity and for quality of life (Vuori, 1995).

High levels of physical fitness among children have been shown to have both short- and long-term benefits (Dennison et al, 1988; Harsha 1995; Malina 2001). A remarkable decline in frequency of physical activity after the age of 12 can be seen among children (Telama & Yang, 2000). Aerobic fitness remains stable in boys and gradually declines during adolescence in girls (Eisenmann, 2004). Even at very young age, boys are reported to participate in more physical activity than girls (Hussey et al, 2001), especially in more vigorous activity (Riddoch et al, 1991).

Boys' activity levels did not decline so early in life as they did progressively among girls (Armstrong et al, 2000).

Antecedents very early in children's life, already during the foetal period, have been shown to be important for adult health. Low birth weight has been documented as being indicative of heightened risk of disease and early infant mortality (Karlberg, 1977; Wilcox & Skjærven, 1992). Prenatal influences on adult disease have been studied by Barker and colleagues, and there is an increasing interest in birth weight as a predictor of disease not only in infants and children, but also in adults (Barker et al, 1993a). Outcome measures in these studies have been diseases such as cardiovascular disease, hypertension and diabetes mellitus (Barker et al, 1993b). Conditions during the whole of childhood are of importance for adult health. Indicators of social problems seemed to be more important as predictors than economic conditions. Some factors during early childhood and/or in foetal life make a biological imprint on the human organism in a way that makes it more susceptible to illness later in life (Lundberg, 1993). Health and health-related behaviours of the parental generation are known to influence the foetal environment in various ways. Thus birth weight may reflect maternal childhood (Alberman et al, 1992). Getting the energy balance right is important, not only from birth, but before conception. Both maternal undernutrition and overnutrition may affect later levels of obesity in offspring (Whitaker & Dietz, 1998). Infant and child health indicators are much more important than merely being restricted to infancy or childhood: The child is father to the man – or mother!

Childhood is considered to be an active stage of life, but many studies indicate that children have become less physically active in recent decades (Boreham & Riddoch, 2001; Luepker 1999), which could be seen as worrying for future generation adults. Many children in developed countries have been shown to become more obese, physically inactive and to spend a great part of their free time in sedentary pastimes (Booth, 2000; Goran et al, 1999; Falkner & Michel, 1999; Donnelly et al, 1996; US Department of Health and Human Services, 1996). Physical fitness and endurance have also declined in recent decades (Luepker, 1999; Westerståhl et al, 2003).

It has been suggested that degenerative biological processes are initiated during infancy and childhood, and that these processes will manifest themselves in chronic diseases later in life. There are studies that have shown that the individual is programmed for susceptibility to later disease through early biological events (Barker, 1990; Malina, 1996; Telama et al, 1997; Taylor et al, 1999; Janz et al, 2000; Raitakari et al, 1997; Togashi et al, 2002). These events could be triggered by an environmental influence, for example inadequate nutrition, smoking, and physical inactivity (Van Lenthe et al, 2001).

Childhood origins of adult health

Most of the research literature in the following chapter is about physical inactivity and much less is about physical activity. Many of the references in the introduction focus on the negative consequences of inactivity and not so many focus on the positive consequences of activity, which could be seen as strange in a work like this with primarily a salutogenic approach. This is explained by the biomedical tradition, with most of the previous research performed using a pathogenic approach.

Attention has been drawn to the importance of childhood for morbidity and mortality in adult life. Fitness and physical activity levels in childhood tend to track into adulthood (Malina, 1996; Telama et al, 1997; Taylor et al, 1999; Janz et al, 2000; Armstrong et al, 1994), and are suggested to reduce the risk of different diseases in adulthood (US Department of Health and Human Services, 1996), such as cardiovascular diseases (Raitakari et al, 1997) and obesity (Togashi et al, 2002). Tracking is defined as the maintenance of relative rank within age-sex group, so that a measurement over time tends to follow a pattern where initial measurements predict later levels in the same individual (Malina, 1996). Malina concluded that activity tracks moderately during adolescence and from adolescence into adulthood. Besides the physical benefits, childhood physical activity is important for socialization into a physically active lifestyle (Riddoch et al, 1991). Physical activity is considered to be a habit that is established in childhood. Significant others such as parents play an important role for the modelling (Sääkslahti et al, 1999; Taylor et al, 1994). Inactive behaviours adopted in childhood tend to track better than active behaviours through the transition from adolescence to young adulthood (Raitakari et al, 1994).

High physical fitness has been shown to have many positive effects on health and longevity (Balady, 2002; Walsh, 2002; Blair et al, 2001; Hensrud, 2001). Most of the studies in this area, however, are about the opposite: the negative effects of low physical fitness. One of the first studies to demonstrate an association between physical fitness and all-cause mortality was a study conducted among adults by Stephen Blair (1989). Participants with the lowest fitness levels had the highest risk of death during follow-up. Blair and colleges concluded that high levels of physical fitness appear to delay all-cause mortality (Blair et al, 1989). Many other studies have confirmed the association between low levels of physical fitness and all-cause mortality risk among adults (Pfaffenbarger et al, 1986; Pfaffenbarger et al, 1993; Myers et al, 2002; Wannemethee et al, 1998; Blair et al 1995; Erikssen et al, 1998) and to reduce the risk of dying prematurely (Erikssen, 2001).

High fitness levels are not only important for longevity. Physical activity and high fitness levels are also important determinants associated with excellent work ability (no sick leave) (Lindberg, 2006). The same phenomenon with the focus on the negative aspects can also be seen in the work-related research area. Most of the studies are about disorders and diseases and not about the healthy examples. Work-

related musculoskeletal diseases account for a large number of workers' compensation days and disability (Bongers et al, 1993; Haldeman, 1991; Holmström, 1992; Andersson, 1993; Ekberg & Wildhagen, 1996; Van der Windt et al, 2000; Bongers et al, 2002; Försäkringskassan, 2005a). The number of people on long-term sick leave increased dramatically in 1997 in Sweden. The rate increase in sick leave continued until 2002, since when the rate has decreased somewhat 2002. On the other hand, the number of people with early retirement pensions increased by 15% during 2002–2004 (Försäkringskassan, 2005b). The main reason for premature retirement has been shown to be musculoskeletal disorders (Edén et al, 1994), which have increased especially among female blue-collar workers (SOU, 2002). The term "musculoskeletal disorders" (MSDs) refers to conditions that involve the nerves, tendons, muscles, and supporting structures of the body. Individual factors may also influence the degree of risk from specific exposures. There is evidence that some individual risk factors influence the occurrence of MSDs, e.g. age, elevated body mass index, smoking, relative muscle strength, and physical fitness (Holmström, 1992). The number of jobs in which workers routinely lift heavy objects, routinely perform overhead work, work with their necks in chronic flexion position, or perform repetitive forceful tasks is unknown; a large number of workers may work under these conditions.

Physical activity and bodyweight

In modern society weight gain and obesity are common health concerns. Food intake seldom varies when occupation changes, with a resultant imbalance between energy input and output. If energy intake exceeds energy needs by as little as 105 kJ per day, then a person will become obese over time. When energy intake equals energy expenditure, body energy stores must remain constant. In children, this process is complicated by additional energy needs for growth. Obesity is the result of a mismatch between energy intake and energy needs, resulting in net accumulation of energy stores in the body and development of obesity (Goran & Treuth, 2001).

It has been difficult to demonstrate that physical activity plays a significant role in the development of excess body fat during childhood. A child's total energy expenditure is the sum of resting metabolic rate, thermogenic effects of food, energy cost of growth, and energy expended as activity. The largest contributor is the resting metabolic rate, accounting for about two thirds of the total energy expenditure. The principal remaining contributor is physical activity (Delany, 1998), which varies from child to child. Studies showed evidence supporting the link between physical inactivity and obesity of children (Tremblay & Willms, 2003).

It has been suggested that the increase in obesity is the result of reduced physical activity (Kuboonchoo, 2001; Hu, 2003; Kaur et al, 2003; Jago et al, 2005). Re-

duced fat and calorie intake and frequent use of low-calorie food products have been associated with a paradoxical increase in the prevalence of obesity. These diverging trends suggest that there has been a dramatic decrease in total physical activity related to energy expenditure (Heini & Weinsier, 1997). Many studies indicate that children and adults have become less physically active in recent decades (Boreham & Riddoch, 2001; James, 1995).

The prevalence of overweight and obesity has increased in all ages (Chinn & Rona, 2001; Jebb et al, 2004; Eisenmann, 2004; Heude, 2003). The rising trends in overweight children are likely to be reflected in increases in adult obesity and associated morbidity in future (Chinn & Rona, 2001; Eisenmann, 2004; James, 1995). The epidemiological results from cross-sectional studies vary, with some suggesting that obese children were less physically active than non-obese (McKenzie, 1991; Sallis, 1991; Janzet al, 1995; Trost, 2003; Fonseca & Gaspar de Matos, 2005; Southhall et al, 2004) and others suggesting that energy intake was more important than activity for the development of obesity (Obarzanek, 1994; Sunnegårdh, 1986; Sallis et al, 1988). Although there are physiological and genetic influences on the various components of energy metabolism, it seems unlikely that the increased global prevalence of obesity has been due to a change in the genes. It is more likely due to behavioural changes. The most striking behavioural changes have been the increased reliance on energy-dense food and an ever-increasing sedentary lifestyle with reduced physical activity (Goran & Treuth, 2001). A significant proportion of overweight children may be at increased risk of further gains in adiposity because of low levels of physical activity (Trost, 2003). Results from a longitudinal study with eight years of activity monitoring and repeated anthropometry measures among children aged 4–11 showed that higher levels of physical activity during childhood lead to the acquisition of less body fat by the time of early adolescence (Moore, 2003). Coronary heart disease risk factors in 12-year-old schoolchildren were mainly associated with physical activity levels, independently of fitness, fatness, and fat intake (Bouziotas et al, 2004).

Genetic factors are important for becoming overweight, but also the influence of parents, siblings and other relatives is important for eating and activity behaviour. An influence of socio-economic factors with a predominant effect of the mother's educational level, rather than financial resources, has been suggested to affect overweight among children (Klein-Platat et al, 2003), but also paternal obesity (Savva et al, 2004). A study performed with rural children in Belgium showed that television watching was positively associated and sport activities negatively associated with bodyweight, particularly in boys. The study also suggested that the socio-economic conditions of the family were involved in children's exercise and television habits (Guillaume et al, 1997). Some gender differences have been studied. Predictors of future overweight in early adolescence were shown to be triglycerides and HDL-cholesterol levels together with paternal obesity. More males in early adolescence remained overweight than females did after one year follow-up

(Savva et al, 2004). Young school girls (7–9 years old) were more likely to be overweight than boys in a study performed by Wang et al in Australia (2002). The prevalence rates of overweight in older boys (13–15 years old) were significantly greater than in other age groups (Wang et al, 2002). Childhood overweight was associated with behavioural problems among girls when they started school, but not among boys (Datar & Sturm, 2004a). Overweight children had significantly lower math and reading test scores than non-overweight children in the first year of elementary school. This can be explained by the association with socio-economic characteristics. It was concluded that overweight was more easily observed by other children than socio-economic characteristics, and its association with poorer academic performance can contribute to the stigma of overweight very early in children's lives (Datar & Sturm, 2004b). No difference was found in absolute VO_2 max (L/min) values in obese or normal-weight children, but when referenced to body weight obese children were found to be less fit (Ward et al, 1995).

The lifetime health and economic consequences of obesity are substantial. Disease risks and costs increase substantially with increased body mass index. For example, the risk of hypertension is roughly twice as high, and the risk of diabetes mellitus is three times a high for moderately obese as for their non-obese peers. Lifetime risks of coronary heart disease and stroke are elevated and life expectancy is reduced. The costs of medical care and treatment are high (Thompson et al, 1999; Birmingham et al, 1999; Wang et al, 2002). The proportion of costs with obesity-associated diseases among children has increased dramatically in the last few decades. This may reflect the impact of increasing prevalence and severity of obesity. Diet and physical activity interventions should be developed in youth (Wang & Dietz, 2002; Philippas, 2005).

Socialization in physical activity

Initial attempts to explain children's participation in physical activities focused on parental modelling. Moore et al found that more active parents are more likely to have active preschool children (Moore et al, 1991). Young children's activity levels, as with all other behaviour patterns, are modelled on those of their parents (Simons-Morton et al, 1997; Stucky-Ropp & DiLorenzo, 1993).

The concept of *habitus* was defined as the total discursive environment of a person. Habitus is a system of embodied habits, dispositions and preferences, which determine the behaviour, thinking, interpretation and valuation of the environment and which are developed early in life. This includes the person's beliefs and dispositions and prefigures what may be a choice. A person's habitus cannot be fully known to the person, as it exists largely within the realm of the unconscious, and includes things such as body movements, prejudices, preferences, body language, postures and dispositions. Furthermore, it also includes the most basic as-

pects of thought and knowledge about the world. Habitus is internalized into a disposition that helps the person to orientate in the world around, to make it comprehensible and to think and react in different situations. Habitus could be seen as the site of the internalization of externality and the externalization of internality (Bourdieu, 1986; Bourdieu & Passeron, 1990). It appears that social learning variables are important correlates of physical activity in children (Stucky-Ropp & DiLorenzo, 1993). Lifestyles could be seen as a bunch of choices made from the embodied taste, practical habitus!

The taste for physical activity has social origins. It is not a totally free choice to exercise or not. The limitations of choice are restricted and ruled by the cultural and social environment in which young people grow up. The taste for different physical activities could be seen as a cultural expression (Engström, 1999).

Many theories have discussed the choice of behaviours, and not all will be discussed here. The theory of reasoned action was developed by Ajzen and Fishbein (1980). This model proposes that exercise behaviour is predicted by intention to engage, which in turn is predicted by the individual's attitude towards exercise and the perceived social norm. The attitude is a function of the perceived consequences of participating and a personnel evaluation of these consequences. There is a decision-making process underlying the exercise behaviour, with both the attitudinal and the normative components involved (Ajzen & Fishbein, 1980).

Bandura's (1986) social learning theory has been used to explain participation in physical activity. Bandura argued that whether a person persists in a particular behaviour depends upon his/her perception of individual mastery over the behaviour. This sense of self-efficacy develops through personal experiences of success, but also from support from others (Bandura, 1986b), for example parents, peers, or teachers. Individuals who perceive that they are competent are more intrinsically motivated to pursue high levels of challenge and are more persistent and less anxious during their involvement (Harter, 1985). According to Harter's model, significant others such as parents, teachers, and peers play a major part in the information of the outcomes of the activities. Evaluation in the form of reinforcement and modelling of approval towards mastery attempts affects the competence and control dimensions of self-esteem (Harter, 1974). The socialization aspect is crucial in those theories, as the self-esteem development is seen as social in origin.

Motivation for physical activity

There are a number of perspectives and theories associated with attitudes and motivation for physical activity. This thesis does not survey all of them. Some are presented in a short version below.

Physical activity is a behaviour that today can be thought of as being under volitional control. It is possible to be active or inactive, and the attitude is important.

Attitudes develop through many sources. Direct experiences are important as well as socialization (Gazzaniga & Hetherton, 2003). Though definitions vary, most attitude theories are about pro–con, pleasant–unpleasant, like–dislike. The feeling of enjoyment is important for the interpretation of like or dislike of an activity (Ajzen, 1988). Physically active people are more likely to have a positive balance in their self-regulatory strategies about the pro–con of exercise. They experience more benefits than costs when being active (Prochaska, 1994). Attitudes cannot determine behaviour unless they lead to intentions. The more personally relevant the attitude, the more likely it is to predict behaviour, to be consistent over time, and to be resistant to change (Gazzaniga & Hetherton, 2003). Intentions are not only determined by attitudes, but also by social norms. Social norms influence the degree to which children wish to comply with the beliefs and actions of key people around them. Social norms represent social influence from parents, teachers, peers, etc. (Biddle & Chatzisarantis, 1999).

Dominant theories of motivation, where self-perception has been central, are theories based on the construct of self-efficacy, self-perceptions of worth and competence motivation (Biddle & Fox, 1989). Self-esteem is seen as a product of social interactions. The sources for self-esteem development rest primarily in reflected appraisals and social comparison (Weiss & Bredemeier, 1985). Self-esteem is viewed as having a motivational influence on behaviour. Our global view of ourselves is underpinned by perceptions of specific domains of our lives, such as social, academic, and physical domains (Shavelson et al, 1976). Fox developed a model for physical self-perception with sub-domains in self-perceptions of sport competence, perceived strength, physical condition and attractive body (Fox, 1997; Fox & Corbin, 1989).

Affect is considered to be central in formulations of self-esteem. Children who attributed mistakes to lack of ability expressed negative affect towards the task and no longer wanted to participate. In particular, the pride and joy or shame and disappointment that accompany perceptions of competence or incompetence are thought to influence future motivated behaviour powerfully (Harter & Connel, 1984; Rosenberg, 1985). Harter's model of competence motivation, which is derived from White's competence motivation theory (White, 1959), shows that general competence is differentiated into three specific domains: cognitive, social, and physical. Harter's model takes into account the antecedents and consequences of both success and failure (Harter, 1985). Optimal challenge is required for maximized positive self-perceptions. Optimal challenge refers to tasks or situations in which the degree or difficulty is matched to the learner's developmental capabilities. If optimal challenges are mastered, they result in the greatest amount of pleasure (Harter, 1974). This theory could be related to the flow theory of Csikszentmihalyi. Flow tends to occur when a person's skills are fully involved in overcoming a challenge that is just about manageable. Thus the flow experience acts as a magnet for learning, for developing new levels of challenges and skills. Almost any

activity can produce flow provided the relevant elements are present – clear goals, immediate feedback, skills balanced with challenge (Csikszentmihalyi, 1997). When the major types of leisure activities were compared as regards how frequently they produced flow among teenagers, sport activities provided more flow experiences than more passive activities (Bidwell et al, 1997). At the same time, the activities that produce flow are more demanding and difficult and also occasionally produce conditions of anxiety. If leisure time is passive there will be lack of enjoyment, but also avoidance of the risk of tackling something beyond one's abilities. This is a bargain that many people make. Is it worth engaging and investing energy to perform challenging physical activities? It might produce a pleasant feeling of flow, but it will also bring about increased risk of unpleasant feelings like anxiety.

Behavioural intent, according to Ajzen and Fishbein (1973), is the immediate antecedent of behaviour. It is an individual's resolution to perform a specific act with respect to a given stimulus in a given situation. It is the attitude to a specific behaviour that is relevant, not attitudes towards objects, people, or situations (Ajzen & Fishbein, 1973). The behavioural intent is a function of two factors; the individual's attitude towards performing a specific behaviour and the individual's perception of the social pressures to act in a specific manner. Ajzen and Fishbein state that one of these factors is not sufficient to determine behavioural intent; you need both.

Bandura discusses the importance of self-regulatory and self-reflective aspects of behaviour. He argued that much of our behaviour is motivated and regulated by internal standards and self-evaluative reactions to our own reactions (Bandura, 1986 a). By this process, people evaluate their actions against some expectations or desire, and then modify their actions accordingly. Self-efficacy is defined as the individual's perception that he/she will be able to perform a specific behaviour successfully. A belief in one's own competence to execute a task is required to produce a desired outcome (Bandura, 1977 a). Successful performance increases expectations of mastery, while repeated failures diminish them. These efficacy expectations influence what behaviours will be initiated, the degree of effort expended, and the persistence of the behaviour over time. Weak expectations are easily abandoned, whereas strong expectations persist in spite of some negative experiences. However, expectations of successful performance alone will not produce the desired behaviour; necessary skill capabilities and incentives are also required (Bandura, 1977 b). A parallel to the flow-theory of Csikszentmihalyi (1997) could be drawn. The skills are fully involved in overcoming the challenges in reaching the flow experience. In short, you like what you are good at, and you are willing to continue doing it.

Among the thoughts that affect action, none is more central than people's judgments of their capabilities to deal effectively with different realities. It is partly on the basis of self-perceptions of efficacy that they choose what to do, how much effort to invest in activities and whether tasks are approached anxiously or self-assuredly (Bandura, 1986 b).

Health has been discussed as a motivational factor for physical activity. The health belief model was developed by Rosenstock. A person's readiness to take a health action was determined by four main factors: the perceived susceptibility to the disease, the perceived severity or seriousness of the disease, the perceived benefits of the health action, and the perceived barriers to performing the action (Rosenstock, 1988). This model has been used in research among adults and is not appropriate for explaining physical activity among children and adolescents.

Enjoyment is a strong predictor for physical activity among children and has been suggested to be a key construct in explaining the motivation and experiences of sport and exercise participants (Stucky-Ropp, 1993; Kimiecik & Harris, 1996; Hagger et al, 2001). Fun and enjoyment have been used interchangeably. The precise meaning or nature of enjoyment is not totally clear, but has been suggested to be a positive affective response reflecting feelings and perceptions such as pleasure, liking, and fun (Wankel, 1993). Among children the importance of enjoyment and development of perceptions of competence are stressed as a means of encouraging physical activity (De Bourdeauhuij, 1998). Enabling children and adolescents to experience a sense of competence and fun in physical activity can increase their perceived behavioural control and activity levels (Deci & Ryan, 1985). The mental health benefits of physical activity are not only the outcomes of mental well-being. The mental health outcomes could also be looked upon as reinforcers of subsequent physical activity or exercise. Effects of exercise can be perceived in both the short-term and the long-term perspective. Feelings of enjoyment seem more important to maintain activity than concerns about health (Dishman et al, 1985).

"Children are born intrinsically motivated to be physically active. That motivation – if kept alive by physical success, freedom, and fun – will do more than promote the fitness behaviours that add years to life. It will maintain the physical zest that adds life to the years" (Whitehead, 1993, page 7).

In extrinsic motivators, the outcomes originate externally. Approval, money, privileges, penalties, grades, diplomas, and the like are socially arranged, rather than natural consequences of behaviour. When these outcomes are no longer forthcoming, the behaviour declines unless it acquires other functional value. Intrinsically motivated activities are characterized by enjoyment and no external rewards are needed (Deci & Ryan, 1985). When people are intrinsically motivated to do something, for example physical activity, they experience interest and enjoyment, they feel competent and they do not need any external rewards to continue the behaviour. Intrinsic motivation and flow are related and the balance between skills and challenge is important (Csikszentmihalyi, 1997). According to the theory of cognitive evaluation by Deci and Ryan (1985) people are born with a need for competence and self-determination. This innate drive motivates them to seek out novelties, challenges, and incongruities to conquer. The social influence has also been shown to be important for the motivation. Vallerand proposed a model of motivation, where social factors were important for feeling motivated (Vallerand, 1997).

However, when people speak of intrinsic motivation as evidenced by behaviour being performed for its own sake, it is not that simple. Action is not animated by itself. Rather, action ascribed to intrinsic motivators is largely regulated by the effects that either flow naturally from it, or arise from internal standards. Behaviour is not its own reward but it can provide its own rewards. It is personal triumphs that provide the exhilaration (Bandura, 1986 b). Most of the things people enjoy doing for their own sake had little or no interest for them originally. Children are not born intrinsically motivated to sing opera, to play the trumpet, to solve mathematical problems, to read or to write, but with appropriate learning experiences, almost any activity can become imbued with consuming significance. The process by which people develop interest in activities for which they initially lack skills, interest, and self-efficacy is an interesting issue. Positive incentives are often used to promote such changes. This is controversial, however. For example, Deci and Ryan (1985) believed that rewarding people for engaging in an activity is more likely to reduce than to increase subsequent interest in it. Extrinsic rewards reduce intrinsic motivation in two ways: they alter people's perceptions of the causes of their behaviour from personal to external sources, and they lower their feelings of competence. Rewards that appear controlling but are uninformative about competence weaken intrinsic motivation, whereas those that signify competence boost it (Deci & Ryan, 1985). In this view, people's perceptions of the causes of their behaviour influence how they will behave in the future. A sense of personal efficacy in mastering tasks is more apt to spark interest in people than is self-perceived inefficacy in performing competently (Lepper, 1981).

Sense of Coherence

The concept of Sense of Coherence (SOC), propounded by Antonovsky, is proposed as a personal orientation that expresses the way the individual responds to stress in life. SOC contains the sub-components manageability, comprehensibility, and meaningfulness. Manageability is how an individual finds ways to cope with perceived strain in life. Comprehensibility is how an individual perceives the demands in life to be clear and structured. Meaningfulness is seen as the component of motivation, and the way the individual sees life with its purposes and challenges (Antonovsky, 1987). All three sub-components are essential to the SOC. The motivational component meaningfulness seems to be especially important, because without this sub-component the other two, manageability and comprehensibility, will not be persistent. People with high motivation are often committed to what they do and find resources and ways to do it. The SOC is mainly developed during childhood and adolescence (Antonovsky, 1993).

SOC may influence perceived strain and health in three ways: SOC influences whether a stimulus is appraised as a stressor or not, SOC influences the extent to

which a stressor leads to tension or not, and SOC influences the extent to which tension is perceived as stress, which leads to adverse health consequences. Some persons maintain and even improve their health despite a high stressor load (Antonovsky, 1993). The SOC concept has links to the hardiness concept, which is seen as a composite of three intertwined components: commitment, control, and challenge (Kobasa et al, 1985).

The role of SOC in child and adolescent health is largely unexplored. Very few studies have been made with adolescents and SOC. Results from a Swiss study suggest a certain degree of stability of SOC in middle to late adolescence. The SOC scale scores almost reached levels seen in adults and remained relatively stable over time, among adolescents (Buddleberg-Fischer et al, 2001). SOC may potentially be a salutogenic factor in adolescents' adaptation to school-related stress (Torsheim et al, 2001). A strong SOC predicted good health in adult men and women. SOC can be interpreted as an autonomous internal resource contributing to a favourable development of subjective state of health (Souminen et al, 2001).

Physical activity in the school setting – physical education

Young people obtain most of their structured physical activity in two behaviour settings: school physical education and local sport clubs. Not all children have any prior experience of sport activities in leisure time, and the role of physical education and experiences of it is central (Papaioannou, 1997). Schools are the societal institutions where the opportunity, mechanisms, and personnel are in place to deliver health education, fitness activities, and teaching new motor skills to children. The school staff has access to large numbers of children in an environment, and therefore has the potential to support healthy behaviour among young people in all socio-economic groups. Recommendations for physical activity are 30 minutes of moderate-intensity activity each day for adults (Blair et al, 2004). School-age youth should participate every day in 60 minutes or more of moderate to vigorous physical activity (Biddle et al, 1998; Corbin & Pangrazi, 1998; Blair et al, 2004). The allocated curricular time for physical education does not reach this recommended level, and it is assumed that young people are active in leisure time to a sufficient level.

Health education for people has to be meaningful and appropriate, with achievable goals and objectives. Physical education could be seen as health education for young individuals. Other disciplines or school subjects focus almost exclusively on knowledge, while physical education also has a behavioural aspect to a large extent. One of the challenges is that while the principal tool is education, the outcomes sought are often behavioural. An hour a week is not enough to change most behaviour unless you have a very highly motivated clientele. At the same time

as physical activity in daily life has decreased, the frequency of physical education lessons in school has been shown to be less than desirable (Armstrong & Åstrand, 1997; Booth et al, 1997; McKenzie et al, 1995; Simons-Morton et al, 1994). The curricular time for physical education in schools has been cut down in many European countries during the last decade. In Sweden the time was cut when the new curriculum was implemented in 1994. The curricular time allotted in all school years was set at about one hour a week. This gave Sweden position number 24 among the 25 countries in a study concerning time allocated for physical education (Armstrong & Åstrand, 1997). A major barrier to increasing the number of lessons for physical education is the concern on the part of administrators that spending more time in physical education takes away time from scholastic work. It has been shown that this concern was not justified. Even when more time was allocated for physical education it did not result in a decline in academic performance (Shephard et al, 1994).

A few intervention studies which evaluate expanding physical education show varying results. Intervention studies aiming at the benefits of extra physical education have not shown significant and beneficial effects on physical fitness (Kemper, 2001). A programme increased physical activity in school, but physical fitness was not tested (McKenzie et al 2004). The increase in percentage fat mass of overweight children was slowed down with intervention in a study in Germany (Muller et al, 2001).

Aims

General aim

The aim has been to study and increase the knowledge of young people's physical status and physical activity, and to further the understanding of the role of school physical education in a salutogenic public health perspective.

Specific aims

- To investigate and describe physical status, levels of physical activity and anthropometrical measures among children and adolescents, 6–12 and 16–19 years old respectively.
- To compare levels of physical capacity, physical activity, and anthropometrical measures in adolescents attending vocational or theoretical education in upper secondary school.
- To analyse the attitudes towards physical education among children and adolescents.
- To investigate the Sense of Coherence (SOC) among adolescents and to analyse the associations between SOC, physical activity, and attitudes towards physical education.
- To investigate and analyse factors associated with children's self-perceived physical competence and self-reported physical activity.
- To analyse effects of expanded physical education lessons among young children in primary school.
- To analyse correlations between self-reported physical activity and actual physical performance among children and adolescents.

Materials and methods

Settings

The studies were carried out in the south of Sweden. Study 1 (Papers I and II) was performed in spring 1996 among adolescents in upper secondary schools in Kristianstad, a municipality with about 75,000 inhabitants. The students came from both the city of Kristianstad and the rural surroundings. Study 2 (Papers III and IV) was performed among children in Simrishamn municipality in December 2000–December 2003. Children attended two schools which were selected as they were similar in size, structure, and children's background. The schools were situated in two small villages in a rural area.

Design

In Study 1 a cross-sectional design was used. Adolescents in five upper secondary schools attending eight different educational programmes were selected. The upper secondary school in Sweden consisted of 16 different educational programmes, two theoretical and 14 practical (vocational). Approximately 98% of all teenagers in Sweden attend these programmes, which last for three years. The theoretical programmes are preparatory for academic studies at university, and contain the traditional theoretical school subjects. The practical programmes lead to specific occupations. For students in vocational programmes studies contain both traditional theoretical school subjects and vocational education in school and in trainee jobs. Students in both practical and theoretical programmes attend the same schools, i.e. there are no special schools for the vocational education. In the study performed, six practical programmes were selected because they lead to jobs involving physical effort: mechanics, building workers, industrial workers, butchers, hairdressers and assistant nurses. Two theoretical programmes, science and civics, were selected. In all, the students came from 16 classes, two classes in every educational programme, one in the first year of education and one in the third. Physical tests, anthropometrical measures, information on grades, and a questionnaire including the short version of Antonovsky's Sense of Coherence form were used to collect the data.

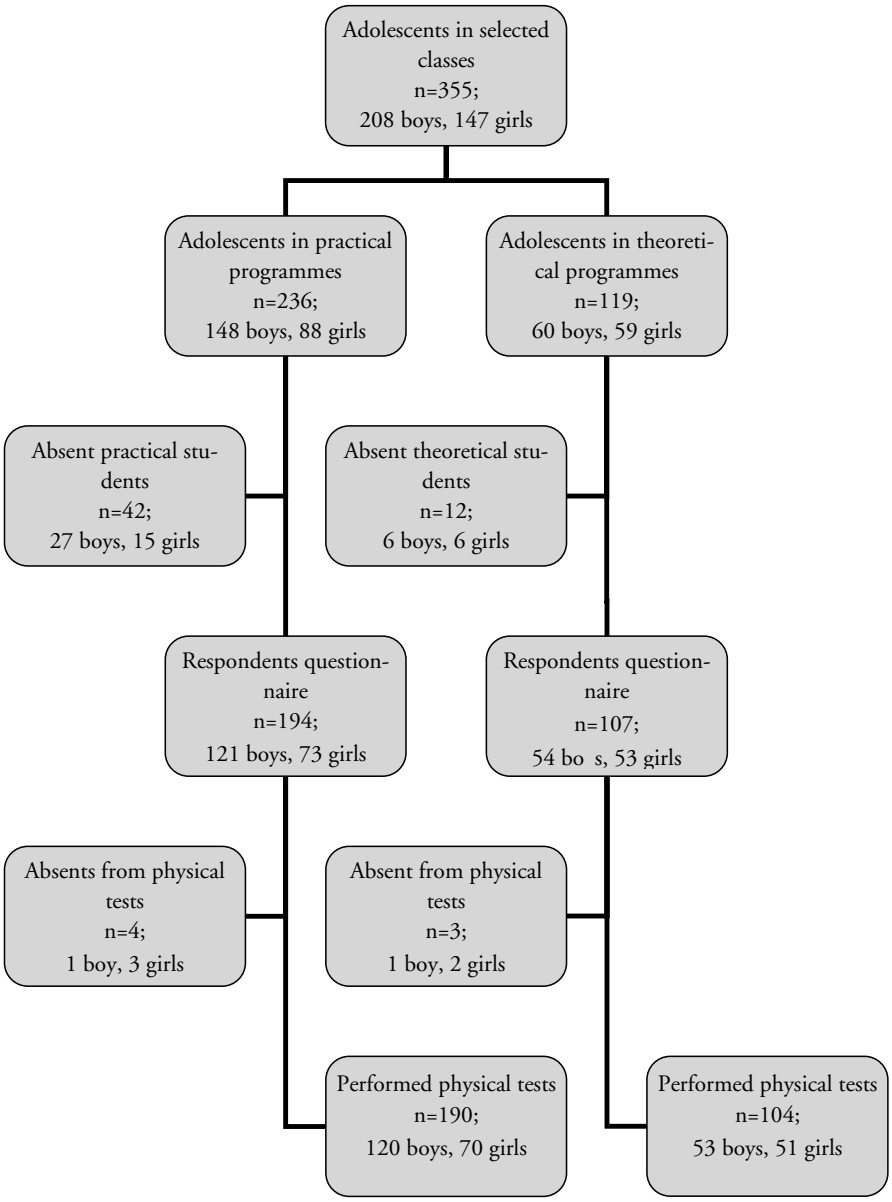
In study 2 the design was a longitudinal intervention study. Baseline measuring was performed in November/December 2000 and annual measuring was done in November/December 2001, 2002, and 2003. After the baseline measurement the intervention study started with expanded physical education lessons in one of two primary schools. The intervention included an increase of allocated time for physi-

cal education. The time was expanded from one or two lessons a week (one lesson=40 minutes including change and shower) to four lessons, with every lesson being guaranteed to last for 40 minutes and time for change and shower was not included. The four lessons were scheduled on four days. On the fifth day, classes had outdoor physical activities with their classroom teacher for about one hour. One physical education lesson a week was performed with boys and girls separated, the other lessons with both sexes. The quality of the lessons was emphasized, with attention on the variety of activities. Obese children had the possibility to have one extra voluntary lesson a week, with special attention paid to motor skills and self-esteem. The increase in physical education lessons was carried out by slight changes in allotment for different school subjects and within the national curriculum. Physical education in the intervention school was taught partly by a physical education teacher and partly by classroom teachers. The other school, the norm school, followed the stipulated curricular time (1–2 lessons a week) and made no changes from their ordinary routine. In the norm school it was taught by classroom teachers. Physical tests, anthropometrical measures, and a questionnaire were used to collect the data.

Samples

In Study 1 a total of 355 adolescents attended the 16 selected classes. From these 355 adolescents, 301 (85%) participated in Study 1 (Figure 1). They were present during the test weeks and completed the questionnaire. Reasons for non-participation were absence from school during the test weeks. Seven adolescents who participated in the study were not able to perform all the physical tests because of injuries or had recently undergone operations.

Figure 1. Participation and dropout among adolescents in Study 1.



In Study 2 a total of 274 children participated in the baseline measurement. The annual measurement in 2000, 2001, 2002, and 2003 included all children at the two schools, but results presented in this thesis are from the baseline in 2000 and follow-up measurement in 2003, and not the annual measuring in 2001 and 2002. Children came in and left the study during the three-year study period, due to the school start at the age of six years, and left school at age 12 years. However, of the 274 children at baseline, 132 participated in the follow-up measurement. These 132 children represent the sample described in Paper IV. Paper III included 206 children 8–12 years old, and describes results from questionnaires and physical testing at the baseline measurement. Of 207 children who were asked to participate, 206 consented (99.5%). Non-participation was due to lack of parental consent. Among these 206 children with parental consent 100% completed the questionnaire and 99% completed all the physical tests.

Measurements

In Study 1 anthropometrical measures, physical tests, information on grades, and a questionnaire including the short version of Antonovsky's Sense of Coherence form were used to collect the data. In Study 2 anthropometrical measures, physical tests and a questionnaire were used. The different measurements will be described below.

Anthropometrical measures

BMI was calculated as body weight in kilograms divided by body height in metres squared (kg/m^2). There are two main reasons for the widespread use of the BMI. First, weight and height are easy to measure. Second, in most individuals the BMI gives a more accurate indication of body fatness than merely using weight-for-height. One limitation of the BMI is that it can give an inaccurate indication of body fatness in some individuals. Most people are overweight because of fat, but some individuals have high BMI because of muscles. Overweight denotes an excess of weight/fat but not to the point where health is impaired. The term obesity indicates a condition in which there is an increase in disease and all-cause mortality risk. Classification of overweight and obesity are most commonly done by BMI. Separate classifications are used for adults and children. There is no universally accepted definition for obesity in children. The usual approach is to use data from a reference group and employ the 85th and 95th percentiles for either BMI or percentage fat as cut-off points for overweight and obesity. Cole's scale, where BMI cut-off points in six large cross-sectional growth studies were extrapolated to provide standards for overweight and obese children and adolescents (Cole et al,

2000), has frequently been used. BMI is a crude indicator of overweight and obesity, and when applied to children, matters of maturational versus chronological age have to be considered.

Children with BMI over the cut-off point for overweight or obesity by gender and age according to Cole et al (2000) were classified as being overweight or obese. For the individual a BMI ratio was calculated as the individual BMI as a percentage of the corresponding cut-off point for age and gender according to Cole et al (2000).

In Study 2 the waist-hip ratio was calculated among children as waist circumference in centimetres divided by hip circumference in centimetres. The waist-hip ratio has been used as a measure of abdominal adiposity, but has lately been superseded by the waist circumference, which has been suggested to give a more accurate estimate of the disease risk associated with abdominal adiposity. In recent years the location of body fat, and not just the total fatness, has been shown to affect the disease risk. In this respect individuals who carry a lot of fat around the abdomen are at increased risk of many diseases. Abdominal fat is stored both underneath the skin (subcutaneous abdominal fat) and within the abdominal cavity (visceral fat). Abdominal fat can be measured using sophisticated techniques, although these techniques are expensive and not possible to use in a field testing situation.

Among children the BMI and waist-hip ratio were standardized for age. In order to standardize each anthropometric measure for age, a regression line was fitted to the data, where age was the independent variable and the measure the dependent variable. For each individual the residual was calculated as the difference between the real score and the predicted score. Thus a positive residual implies a better result than expected according to age, and vice versa for a negative residual. Among adolescents residuals were not used as no differences were found in anthropometric measures between students in different ages.

Physical tests

Physical capacity was assessed by measurements in physical tests among both adolescents and children. The specific tests were chosen because they were possible to carry out in a field testing situation in the schools, and they were presumed to give a spectrum of the students' physical capacity. All physical tests were piloted before use to ensure that they were possible to perform. The tests were performed in the same succession to avoid effects of stretching or fatigue. Individual instructions on the tests were given to all children and adolescents to make sure that they all understood what the tests were like and how to perform them. All students were tested by the same test leader (ACS). The test leader gave both verbal and visual instructions to children and adolescents. In the balance test children and adolescents were asked to try once before they did the real test. Children and adolescents

did one round of the tests. For all students, the test protocols used for collecting the physical performance data were linked to the questionnaire data. Children as well as adolescents did not find the tests difficult to perform, and they seemed to understand the instructions easily. Actually, both children and adolescents seemed to enjoy the testing procedure, and they asked if they could do more tests than were included in the study.

From the physical tests a physical index for each individual was calculated. This index was calculated as $\Sigma(x_i - \bar{x}_i)/s_i$, where i was the number of the test from one to seven/eleven, x_i was the individual's result standardized for age in test number i, $\bar{x}_i$ was the group mean and s_i was the standard deviation for test i. The standardized physical index was distributed around the mean 0. A high physical index indicated high physical capacity of the individual, and a low index low capacity. The index was calculated separately for boys and girls among both children and adolescents.

Among children the results from the physical tests were standardized for age before the calculation of the physical index in the same way as for the anthropometric measures. In order to standardize each test result for age, a regression line was fitted to the data, where age was the independent variable and the test score the dependent variable. For each individual the residual was calculated as the difference between the real score and the predicted score. Thus a positive residual implies a test result better than expected according to age, and vice versa for a negative residual. Among adolescents residuals were not used as no differences were found in test results between students in different ages.

Physical tests used in Study 1

Among adolescents, seven physical tests containing predicted maximal oxygen uptake (VO_2 max), muscular strength in arms, abdomen and legs, flexibility in spine and hamstrings, and balance were used.

Åstrand's cycle ergometer and the Åstrand-Rhyming nomogram (Åstrand & Rodahl, 1986; Åstrand & Rhyming, 1954) with the linear relationships of work rate, heart rate and oxygen consumption were used to estimate the maximal oxygen uptake (MOU) (ml $O_2 \cdot kg^{-1} \cdot min^{-1}$). A correction for the age-predicted peak heart rate was made. The test person cycled on an ergometer cycle (type: Monark) for 5 min with submaximal rate of work (600 kpm/min for girls and 900 kpm/min for boys). Three tests of muscular strength and endurance were carried out. These tests were curl-up test (sit-up) (Bergqvist et al, 1992) to assess abdominal endurance, the Canadian standardized push-up test (Golding et al, 1989) to assess upper body endurance, and the Sargent jump (Bergqvist et al, 1992) to assess dynamic maximal strength in the legs. Adolescents performed the curl-up test lying on the back on a mat with bent knees on a foam plastic pillow, lifting the upper body from the ground keeping a given pace (25 curl-ups and -downs/min). The upper body had

to be lifted so high that the whole shoulder blade left the ground. The push-up test was also performed at a given pace (25 push-ups and -downs/min) with toes touching the ground. The number of curl-ups and push-ups performed correctly was recorded as a score. The Sargent jump is a vertical jump without takeoff, with the height of the jump measured in centimetres (Bergqvist et al, 1992). Two tests of flexibility were performed, one to measure the side flexure in the spine (centimetres), and one to assess the elasticity in the hamstrings, the back of the legs (degrees) (Bergqvist et al, 1992). To test the dynamic balance (Bergqvist et al, 1992), the test person stood on one foot turning the head from side to side. The time in seconds of maintained balance was registered.

Physical tests used in Study 2

Among children eleven physical tests were used. The test battery comprised endurance running, muscular strength in upper body, hands, abdomen and legs, flexibility, balance, and motor skills. Seven of the eleven physical tests were brought from the EUROFIT (1993) test battery which has been used in several studies. The tests brought from the EUROFIT test battery were: sit-ups, standing broad jump, bent arm hang, hand grip, sit and reach, plate tapping and shuttle run. To test the dynamic balance, the test person stood on one foot turning the head from side to side (Bergqvist et al, 1992). The time maintained in seconds was registered.

Endurance performance was assessed by a running test for six minutes, which was developed from the one-mile running test (Ezzell et al, 1991). This test was chosen because it gives a valid measure and is time-efficient. Endurance performance in children is significantly associated with VO_2 max, which is accepted as a good reference standard of cardiorespiratory fitness (Massicotte et al, 1985). High physical fitness, i.e. high-endurance running performance, was associated with more favourable cardiovascular disease risk profiles (Bergström et al, 1997). The test was performed indoors in a gym on a track with about 70 m in circumference. Children were told to run at a moderate to slow tempo at the beginning of the running test and to feel if they were able to increase speed after a while. If they were unable to run all the time they could walk.

Two tests were constructed to include learned motor skills among children. These tests included rope skipping and ball-bouncing. The children skipped for 30 seconds and correct skips with the rope were counted. The number of correct bounce catches in 30 seconds was counted. The period of 30 seconds was chosen because it was long enough to evaluate the skills, was time-efficient, and synchronized with the tests in the EUROFIT test battery.

Questionnaires

Questionnaires were used to collect information on the study variables among both adolescents and young children. They completed the questionnaires during school lessons and could ask if they didn't understand the questions. Conditions were ensured to be the same for all classes by following a similar test procedure. They completed the questionnaires before the performance of the physical tests.

Questionnaire used in Study 1

Questionnaires were piloted before use in another municipality among adolescents in both practical and theoretical programmes. Students were asked to write their view of every question, whether they understood the item, whether the categories were satisfactory or any should be deleted or included, whether any question should be added, etc. The aim of the pilot studies was to expose any problematic questions and draw attention to any alterations that should be made to the survey procedure. As a result of the pilot studies, a few questions were omitted in the questionnaire and some reformulations were made.

Among adolescents SOC was assessed by the short version (13 questions) constructed by Antonovsky (1987). The scores on each question ranged from 1 to 7, thus the SOC value ranged from 13 to 91.

Attitudes to physical education were assessed according to ten statements about physical education. Five of the statements were positive and five negative towards physical education (PE). The positive statements were: PE is a fun subject, PE is an interesting subject, PE is an important subject for future health, PE is a welcome break in school work, PE is a solidarity-creating subject. The negative statements were: PE is a boring subject, PE is an uninteresting subject, PE is an unimportant subject for future health, PE is an unnecessary subject which could leave space for other subjects instead, PE is a competition-creating subject. Those ten statements were arranged in opposite pairs. An index was calculated for each individual, where agreement with the positive statements and disagreement with the negative statements above was scored (+1). Agreement with negative and disagreement with positive statements was scored (–1). The index thus ranged from +10 to –10. The positive/negative statements about PE as a solidarity-creating subject or PE as a competitive subject were excluded in the analyses because of too few individuals.

Self-reported leisure-time exercise was assessed by the question: "How often do you exercise physically in your leisure time so you get out of breath and sweaty?" Three groups were formed out of the seven response categories: regularly three times or more per week, regularly once or twice a week, and the last group – a few times per month or a few times per year or never.

Enough exercise in school was assessed by the question: "Do you think you get enough exercise during lessons in physical education in school to be in good condi-

tion?" with the four response categories: yes completely, yes mostly, no mostly not, no not at all.

Valuation of time for physical education was assessed by the question: "What is your opinion about the time allocated for physical education in your year in school?" with the five response categories: far too much time, somewhat too much time, just enough time, somewhat too little time, far too little time.

Presumed future physical demands were assessed by the question: "Which physical demands do you think will be important in your future work?" The opinions were: aerobic fitness, strength, flexibility, balance, coordination, fast reactions, and precision.

Subjective health was measured by the answers to the item "How do you feel?" with the five response categories very good, fairly good, neither good nor bad, fairly bad, very bad.

Feeling comfortable in school was measured by the answer to the item "How do you feel in school?" with the five response categories very good, fairly good, neither good nor bad, fairly bad, very bad.

Questionnaire used in Study 2

Questionnaires were piloted before use in another municipality among children aged 6–12 years. The aim of the pilot studies was to expose any problematic questions and draw attention to any alterations that should be made to the survey procedure. Pre-testing procedure included administration of questionnaires to young children and the questions were discussed in small groups to determine difficult words. As a result of the pilot studies, a few questions were omitted in the questionnaire and some reformulations were made.

Special attention was paid to the youngest children's ability to understand and answer the questions. For children aged 6–7, a special questionnaire was developed with symbols for the categories. Teachers in elementary school were consulted about the use of understandable words for the children. On the whole, the participants were able to understand the questions. Questions from the questionnaire consisted of understandable words in Swedish for children and adolescents, but some translation problems into English might occur. A test-retest procedure among 66 children from the study group was also performed within a three-week period. Only questions with at least a moderate strength of agreement (Kappa above 0.40) according to Altman (1991) were used in the analyses.

Self-reported leisure-time exercise was assessed by the question: "How often do you exercise in leisure time (even brisk walking is counted as exercise)?" with the four response categories often, sometimes, seldom, and never. Two groups were formed out of the four response categories: 1 High level of physical activity (often); 2 Low level of physical activity (sometimes/seldom/never).

Self-perceived physical fitness was assessed by the question: "How do you think your physical fitness is?" with five response categories: very good, quite good, neither good nor bad, quite bad, very bad.

Self-perceived competence in PE was assessed by the question: "How skilful do you think you are in PE?" with five response categories: very good, fairly good, neither good nor bad, not so good, not at all good.

Self-perceived body function was assessed by the statement: "I am satisfied with my body function" with five response categories: agree totally, agree partly, do not agree nor disagree, disagree partly, disagree totally.

Subjective health was assessed by the question: "We all have small ailments sometimes (colds, for example), but you can feel more or less good anyway. How do you feel most of the time?" with five response categories: very good, quite good, neither good nor bad, quite bad, very bad.

Global quality of life was assessed by the question: "If you think about how things are at home, in school, in leisure time and everywhere else you can think of, how are you getting on with your life?" with five response categories: very good, quite good, neither good nor bad, quite bad, very bad.

The intake of daily meals was assessed by the question: "How often do you eat breakfast/lunch/dinner an ordinary school week?" Two groups were formed. 1 Eat all meals every day; 2 Remaining combinations.

Feeling comfortable in school was assessed by the question: "Do you feel comfortable in school?" with five response categories: very comfortable, quite comfortable, neither comfortable nor uncomfortable, quite uncomfortable, very uncomfortable.

Enjoying PE was assessed by the question: "What do you think of PE in school?" with five response categories: great fun, quite fun, neither fun nor boring, quite boring, very boring.

Television watching by the question: "About how long did you watch TV *yesterday*?" with five response categories: not at all, less than one hour, one to two hours, two to three hours, more than three hours.

The questionnaire also included questions about perceptions of competence in all school subjects, relations to peers, parents, and teachers.

Grades

In the study performed among the adolescents (Study 1) information was collected on all grades given in the relevant classes. All information on the grades was received from the headmasters' offices at the schools. The grades were used as a measure of the adolescents' study results. At the time of the study (1996) there were two systems of grades current in Sweden. Grades used for calculation in this study were the old system with a 5-point scale. The grades were awarded on a 5-

point scale, with 5 being the highest and 1 the lowest. The grades were to be normally distributed with 3 as a mean. Mean grades were the mean of all given grades in the school subjects. PE grade was the grade given in physical education.

Statistical methods

The level of significance was set at $p<0.05$. The significance of differences in qualitative variables, nominal and ordinal scales, was tested by the chi squared test. Numerical variables were tested by Student's t-test and Mann-Whitney's U-test. If there were more than two groups in the comparison, the Kruskal-Wallis nonparametric test and analysis of variance (ANOVA) was used for assessing the significance of differences between means in different groups. Correlations were carried out by using Spearman's correlation coefficient. Testing $\rho=0$, Pearson's correlation coefficient, was done by using the t-test.

Multivariate analyses were carried out by means of logistic regression models. In Paper II, the independent variables were categorized into three groups: "ARE variables" (describing the being), "DO variables" (describing the doing), and "THINK variables" (describing thoughts and attitudes). In Paper III the variables were categorized into two groups, "ARE variables", and "THINK variables". All variables were dichotomized according to the median value.

Because of the salutogenic approach, the results of the logistic regression analyses were expressed as positive odds ratio (POR) and 95% confidence intervals (CI). POR was calculated as the odds ratio, but the positive and negative outcomes were changed (Ejlertsson et al, 2002). By using this concept, the focus was on the positive outcomes instead of the negative ones. If, for example, POR=2.0, when comparing those with high and low self-perceived competence in PE, the interpretation is that those with high self-perceived competence in PE are twice as likely as those with low self-perceived competence in PE to have a positive outcome in the explanatory variable.

In paper IV multiple regression analyses were done with changes in physical index as dependent variable and baseline BMI ratio as independent variable together with the school as a dummy variable.

Data analyses were carried out by using SPSS (Statistical Package for the Social Sciences) Windows versions 6.1, 9.0, and 12.0.

Ethics

All studies presented in this thesis have been approved by the Research Ethics Committee at the Faculty of Medicine, Lund University, Sweden (LU 88–96; LU 520–00). Written information about the study was given to all adolescents. Among

the children informed consent was obtained from every participant's parents after they had received written information. The written information given both to adolescents and to the children's parents emphasized that participation was voluntary.

Results and comments

Physical capacity and physical activity among adolescents (Paper I)

The physical capacity (physical index) was higher among students in theoretical education than in vocational education for girls (1.51 and –1.24 respectively; $p<0.001$) and for boys (1.11 and –0.46 respectively; $p=0.015$). A difference in physical capacity (physical index) was found between the different educational programmes. Girls in science programmes had the highest physical index and girls in programmes for assistant nurses had the lowest index (2.53 and –2.08 respectively). Among boys, the highest index was found among boys in the science programme and the lowest in programme for mechanics (1.50 and –2.59 respectively). Strength and balance indices were higher among students in theoretical education than among students in practical education.

A correlation between self-reported physical activity and physical index was found. Highest physical index was found among adolescents who reported that they were physically active four times or more per week (1.96 among girls and 1.70 among boys). The lowest index was found among adolescents who reported that they were physically active a few times a year (–4.05 among girls and –3.63 among boys). No differences in self-reported leisure-time exercise between adolescents in vocational and theoretical programmes could be seen. Concerning self-reported leisure-time exercise, a gender difference was found in frequency. Among girls, 29% reported that they did some exercise three times or more per week, 45% once a week and 26% seldom or never. Corresponding figures among boys were 38% three times or more per week, 27% once a week and 35% seldom or never ($p=0.003$). The most frequent sports activities in leisure-time among boys were team sports (39%), strength training (28%) and jogging (17%). Among girls the most frequent sports were aerobics (41%), jogging (21%), team sports (13%) and riding (13%).

A correlation was found between physical index and how students valued the time allocated for physical education (PE). Those who thought that too much time was allocated for PE had the lowest physical index, and vice versa, those who had the highest physical index thought the time was too little. Asking what physical requirements future work will put on them showed that strength and aerobic fitness were the most important qualities for many adolescents (71% and 68% respectively).

A correlation was found between physical index and average grades among both girls ($r=0.43$; $p<0.001$) and boys ($r=0.22$; $p=0.008$).

The boys in theoretical programmes were taller than boys in vocational programmes (180.0 and 177.2 respectively; p=0.023). The percentage of girls with low oxygen uptake was higher than among boys (p=0.001). Among girls 19% (22% in practical and 14% in theoretical programmes) were below the level at which they run the risk of cardiovascular diseases (32.5 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$). Among boys, 6% (5% in practical and 6% in theoretical programmes) were below the level for men (35 ml 0_2 kg^{-1} min^{-1}).

Comments

Students who attended vocational programmes had lower physical capacity than students in theoretical programmes. The lower physical capacity among students undergoing education for occupations involving physical load may place those individuals at greater risk of being injured early in life in their work. The physical status with which the young people start their working career is important. Being unaccustomed to work seemed to increase the risk of musculoskeletal disorders (Häkkänen et al, 2001). Therefore it is important to be fit in order to be able to start one's career without injuries that may be persistent.

The correlation between average grades and physical index was an interesting finding, although the causality is unclear. A relationship between physical fitness and academic achievement in terms of reading and mathematics was shown in the California study including one million children between 10 and 14 years (National Association for Sport and Physical Education, 2002). In our study the correlation between grades and physical capacity could be seen among students in theoretical education as well as among students in vocational education, which means that the achievement in additional school subjects was also correlated with physical fitness. This is especially interesting from the vocational point of view. Physiological mechanisms, such as increased blood flow, alteration in brain transmitters and changes in the nervous system, are based on the physical changes in the body brought about by physical activity. Physical activity improves physical fitness and psychological health and mood, which is important for well-being in general, to support cognitive development and to facilitate learning (Mutrie & Parfitt, 1998; Sibley & Etrier, 2003).

Sense of Coherence and attitudes to physical education among adolescents (Paper II)

The mean value of the SOC scores in the group of adolescents (n=285) was 62.6 (SD=10.50). There were no differences between the SOC scores of girls (n=127), 62.8 (SD=10.01), and boys (n=158), 62.4 (SD=10.91; p=0.788). Comparison be-

tween girls' and boys' scores in the sub-components (girls n=128–129; boys n=159–167) showed differences. Girls had higher scores on meaningfulness, 21.2 (SD=3.57) than did boys, 19.8 (SD=4.26; p=0.004) and boys had higher scores on manageability, 20.0 (SD=4.48), than girls, 18.9 (SD=4.07; p=0.045). No difference in the score of the sub-component comprehensibility was found, boys 23.5 (SD=5.56) and girls 23.5 (SD=5.22; p=0.938).

The mean score in SOC differed between positive statements and negative statements concerning enjoyment, interest and necessity. The scores in the sub-component meaningfulness differed between positive and negative statements, but no differences were found concerning the two other components, manageability and comprehensibility. Adolescents who agreed with positive statements reported physical activity in leisure-time to a higher extent than their peers who agreed with negative statements. The physical index was higher among students who agreed with positive statements, and those students also thought the time allocated for physical education (PE) was insufficient.

The relationship between attitudes to PE and the "ARE, DO, THINK variables", was studied in logistic regression analyses. High physical index (POR=2.8), strong SOC (POR=2.1) and high grade in PE (POR=2.2) were significantly related to positive attitudes to PE among the ARE variables. Among "DO variables", high frequency of self-reported exercise in leisure-time (POR=2.3) and little time spent on watching television (POR=2.1) were significant. Furthermore, a relation between positive attitudes and opinions about insufficient time allocated to PE in school was found (POR=5.7). The other variables were not significantly related to attitudes towards PE in the analyses. Variables related to high scores in SOC were high grade in PE (POR=2.1), very good subjective health (POR=2.8), feeling comfortable in school (POR=2.6) and positive attitudes to PE (POR=1.8).

Comments

The positive relationships between SOC and attitudes to PE, between attitudes to PE and physical activity in leisure time, and between physical activity and physical capacity (physical index) indicate an interesting chain of associations. According to Antonovsky, SOC is mainly developed in childhood and adolescence (Antonovsky, 1993). Positive attitudes to PE and physical activity could influence the actual SOC. The interrelation between SOC and attitudes to PE indicates the possibility to affect the development of SOC through positive experiences of PE in school. This could be important for the motivation for lifelong physical activity and for improved adult health status. The role of SOC in child and adolescent health is largely unexplored, so the results are interesting and of pioneering character. In all, very few studies have investigated relations between SOC and physical activity, and therefore these results add new information.

The variables related to positive attitudes towards physical education were high physical index, high grade in physical education, little television watching, and opinions regarding insufficient time allocated for physical education, which all are aspects of activity. Adolescents with positive attitudes to physical education seemed to be active at present, but also wanted to be more active. They had higher SOC scores, which could be seen as an internal resource for a more favourable development of subjective state of health, the way they perceive themselves in the environment. They had higher scores in the sub-component meaningfulness, defined as the motivational component. Those adolescents had high levels of physical capacity, their SOC score level was high and their motivation for physical activity high. These adolescents might become physically active adults with reduced chronic diseases because of past and present physical activity.

Self-perceived physical competence among children (Paper III)

High level of self-reported physical activity was associated with membership of a sports club (POR=3.4) and high self-perceived physical fitness (POR=2.5). High self-perceived competence in PE was associated with low age (POR=1.5), male gender (POR=2.3), high physical index (POR=2.4), living with both parents (POR=2.8), high self-perceived physical fitness (POR=5.5), and enjoying PE (POR=4.8). High self-perceived physical fitness was associated with low age (POR=1.8), high level of self-reported PA (POR=2.9), high performance in endurance running (POR=2.0), positive self-perceived body function (POR=4.1), and high self-perceived competence in PE (POR=5.6).

Of 205 children, 105 reported that they exercised often (51%). This group of active children (105 children) had a higher physical index than the group of not so active children (100 children) (mean 0.65 and –0.78 respectively; p=0.003). The physically active children also had higher results in endurance performance residuals than less active children (mean 0.19 and –0.20 respectively; p=0.004). Concerning the anthropometric measures, the physically active children had lower BMI residuals than less active children (mean –0.48 and 0.50 respectively; p=0.020), and waist-hip ratio residuals (mean –0.0091 and 0.0094 respectively; p=0.003).

A higher percentage of children with high level of physical activity were satisfied with their body function than children with low level of physical activity (72% and 55% respectively; p=0.009) irrespective of BMI. Children with high level of physical activity perceived themselves to be competent in PE to a higher extent than low level children (72% and 58% respectively; p=0.040). They also perceived their physical fitness to be good to a higher extent (56% and 30% respectively; p<0.001).

A stepwise distribution of mean physical index could be seen in the groups of

children with different self-reported physical activity, self-perceived competence in PE and self-perceived fitness. The highest mean physical index was found among children with high self-reported physical activity, high self-perceived competence in PE and high self-perceived physical fitness.

Comments

Self-perceived physical competence among children aged 8–12 years was investigated from two different aspects – physical competence in PE and physical fitness. These two aspects were correlated, but they also reflected different situations for the child. Active children perceived their body function as better and their physical competence in PE as higher than less active children did, which has been shown to be a deciding factor for participation in physical activity (Ferrer-Caja & Weiss, 2000). They seemed to be satisfied with their body experiences, which might influence the motivation to participate in physical activity. Sonstroem and Morgan (1989) proposed that effects of physical activity can change the body image and by extension the self-esteem. The active children had a higher physical index, lower BMI and waist-to-hip ratio than less active children, which has been shown to be more favourable for health (Flodmark et al., 1994; Seidell et al., 2001; McCarthy et al., 2003).

Enjoyment has been found to be a major reason for children to be physically active. If children's skills are raised, physical activity could be more pleasant and enjoyable with more positive self-perceptions, which in turn could be motivating for more physical activity. The curricular goal in physical education to develop skills among children must not be forgotten. The motor ability should be trained early in children's life. The self-perceived competence and feelings of enjoyment have been shown to influence the motivation and persistence in physical activity (Weiss & Ebbeck 1996; Harter, 1985).

Benefits of expanded physical education lessons among children (Paper IV)

Comparison between baseline and follow-up in changes in physical performance (physical index including eleven physical tests) among children (n=121) in intervention school and norm school showed significant differences between the two schools. Children in the intervention school had more positive changes in physical index than in the norm school (1.09 compared with –1.19; $p=0.003$), as well as in endurance performance (1.42 and –1.16 respectively; $p<0.001$) motor skill performance (0.57 and –0.65 respectively; $p=0.010$). No differences in changes in strength performance were found between the two schools. Changes in Body Mass

Index (BMI) were significantly better in the intervention school than the norm school (–0.32 and 0.25; p=0.033). The same trend could be seen among both boys and girls.

Among all children in the two schools (n=132), 110 children were classified as normal weight at baseline. In this group of children (n=110), 19 children (17%) were classified as overweight at follow-up. No significant difference between the schools could be seen. Group mean for the ratio of all children's BMI in relation to Cole's reference standards for age and gender was 87% in baseline and 93% in follow-up. Thus the mean change in BMI ratio from baseline to follow-up was 6% upwards among all children.

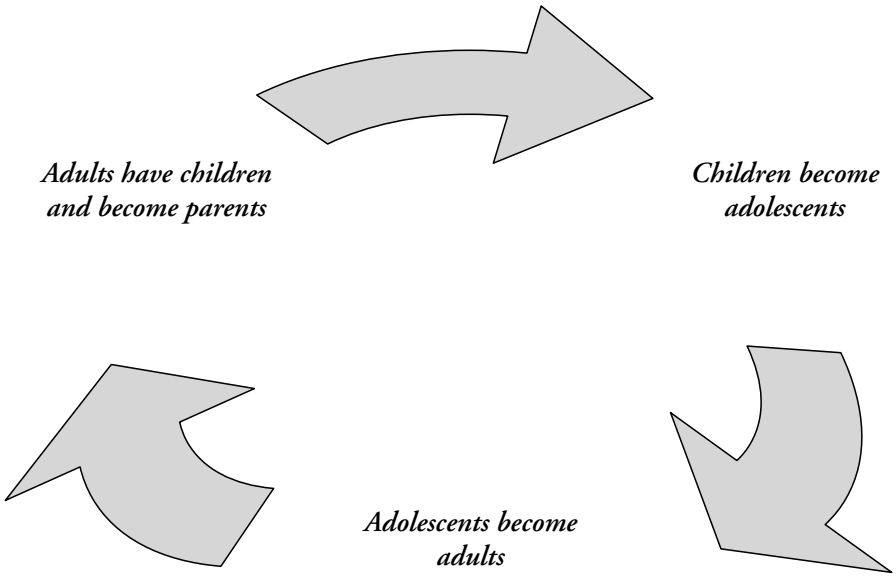
A multiple regression analysis stated that the school the children attended was important for the changes in physical index (p=0.003), while the baseline BMI ratio was not significantly related to the changes in physical index (p=0.997).

Comments

An intervention study was performed where the amount of physical education lessons was expanded in primary school. The results showed that with this intervention – an increase to four physical education lessons a week – the physical capacity improved among children. The increase in BMI was slowed down, but was not totally prevented. The complexity of the overweight problem is multifaceted. The intervened dose of physical activity was probably not enough to compensate for both increased energy intake and/or lack of natural physical activity. The average decline in daily energy expenditure from the end of the Second World War to 1995 has been estimated as 3360 kJ (800 kcal), the equivalent of walking about 16 km less (James, 1995). The recommendations for school-age youth state that children should participate daily in 60 minutes or more of moderate to vigorous physical activity (Strong et al, 2005). If the responsibility for children's daily physical activity were left totally to school to handle, it would be necessary to increase the amount of physical education lessons to a higher level, which would come into conflict with the academic subjects. There is already congestion and the time allocated for physical education has been cut down, much in favour of the academic school subjects (Armstrong & Åstrand, 1997).

General discussion

Life is a sequence of different periods. Physical capacity and physical activity could be seen as a continuum in these different periods in life. Adolescence is an interesting period in life, somewhere between childhood and adulthood. Adolescent physical capacity and lifestyle patterns could be seen partly as a result of childhood and partly as a prediction of adulthood. Young today and adult tomorrow! Child today and parent tomorrow!



Physical activity and physical fitness among children and adolescents are not only important for health in youth, but also for health in adulthood. It is important to increase the amount of active people. This is urgent in all ages in life, but could be seen as crucial among children and adolescents as they will become the next generation of adults. Physical inactivity is seen as a major public health problem. Not only adults are physically inactive to a high extent. Many young people have also adopted a sedentary lifestyle. Overweight is a visible consequence of inactivity and imbalance in energy intake and energy expenditure. Childhood over-

weight brings a number of problems, but the greatest problems will be seen in the next generation of adults as the present childhood obesity epidemic has been shown to pass through to adulthood. Other chronic diseases in adulthood have also been shown to have antecedents in childhood.

Physical inactivity is a huge problem in society, also among young people. The question is whether school can restore the balance. What changes are policy makers, school administrators, teachers, parents, and students ready to accept in the curriculum and time schedule? The physical inactivity problem does not begin at the school gate and does not end on the way out of school. It is involved in young people's various living and social environments.

The overall aim of this thesis has been to increase the knowledge of young people's physical capacity and physical activity, bearing in mind that they will soon be adults. Another aim was to further understanding of the role of school physical education in a salutogenic public health perspective. Schools are important arenas for physical activity promotion as they are the societal institutions where the opportunity, mechanisms, and personnel are in place to deliver fitness activities and health education to children. The school staff has access to large numbers of children in an environment, and has the potential to support healthy behaviour among young people in all socio-economic groups. As some children do not have any prior experience of sport activities in leisure time, school physical education is important as a habituation into a physically active lifestyle for all children (Papaioannou, 1997).

The amount of allocated time for physical education has been debated intensely. At the same time as physical activity in daily life has decreased (Boreham & Riddoch, 2001; Luepker 1999; Engström, 1990), the frequency of physical education lessons in school has been shown to be less than desirable (Armstrong & Åstrand, 1997; Booth et al, 1997; McKenzie et al, 1995; Simons-Morton et al, 1994). The recommendations for physical activity are 30 minutes of moderate-intensity activity each day for adults (Blair et al, 2004), whereas school-age youth should participate every day in 60 minutes or more of moderate to vigorous physical activity (Corbin & Pangrazi, 1998; Blair et al, 2004). In view of the reduction in physical education, it is justified to be sceptical about the extent to which physical education is really in a position to solve current problems of physical inactivity and obesity among children. Very few intervention studies with expanded physical education have been performed and evaluated, and the knowledge in this area is low.

This thesis contains two studies with different age groups, and they will be discussed more carefully in the following text, but first a short summary to give an early conclusion as to the main findings. Differences in physical capacity were found in adolescents attending different educational programmes, i.e. there were differences between prospective blue-collar and white-collar workers already during education. Differences in physical capacity in children in primary school were also

found. Among both children and adolescents the physical capacity was correlated to the amount of self-reported physical activity in leisure-time. The highest physical capacity was found among children and adolescents who reported a high frequency of physical activity, and the lowest among those with low physical activity. This led to the hypothesis that if the level of physical activity could be raised, the physical capacity among children would probably improve. The physical activity level could be raised via the school physical education. An intervention study was performed, where the amount of physical education lessons was expanded in one primary school, while another school followed the stipulated curricular time. The results showed, in a three year follow-up, that the physical capacity was improved among children in the intervention school, whereas it was not in the norm school. The findings of the study suggest that there is a possibility to reduce the differences in physical capacity between groups of children. More details from the studies will be discussed below.

The differences in physical capacity between theoretical and vocational students indicated significant differences between prospective blue-collar and white-collar workers already during education. The higher physical capacity among students in theoretical education might give them a good chance of a healthy adulthood, whereas the lower physical capacity among students undergoing education for occupations involving physical load may place those individuals at greater risk of being injured early in life in their work. A higher prevalence of musculoskeletal morbidity has been found among blue-collar workers than among white-collar workers (Andersson et al, 1993; Ekberg & Wildhagen, 1996; Bernard, 1997; Van der Windt et al, 2000; Bongers et al, 2002). Indeed, it is urgent to raise the physical capacity in youth to promote a good start in working life and to prevent an increase in sick leave rates and early retirements. For both individual and society there would be considerable gains if the amount of people with work-related diseases and disorders could be reduced. When physical demands are high, it is even more important to have an acceptable level of physical capacity to carry out the strain without injuries, which could lead to sick leave and/or early retirements. The main reason for premature retirement was musculoskeletal disorders (Edén et al, 1994). It is not the biomechanical factors alone that contribute to the perceptions of work load. There are several psychosocial factors where the coping possibilities are important (Kristensen, 1991).

The individual level of physical capacity could be seen as the margin the individual has to play with in the working situation. If the margin is high between ordinary work requirements and maximal capacity the perceptions will be that the work load is not so strain. On the contrary, if the margin is low, the load will be perceived as high and personal physical and psychological coping strategies will be needed. Physical activity in leisure-time was found to be an important determinant associated with excellent work ability (no sick leave) when several factors in private and working life were investigated as determinants of work ability (Lindberg,

2006). Every sport has its special demands, as does every action in working life. As the sportsman prepares for the sport, the worker should be prepared for work with a margin between ordinary work requirements and maximal capacity. To be in good shape is not only important for people in occupations with physical strain, it is important in all occupations, also in sedentary and monotonous work.

The differences between physical capacity among adolescents in practical and theoretical programmes seemed to be more pronounced among girls. Low physical capacity among girls in vocational education might lead to musculoskeletal disorders and sick leave. The musculoskeletal problems have increased among female blue-collar workers in recent decades. In all, women dominated among the workers long-term sick leave (Försäkringskassan, 2005a; SOU, 2002). From the point of view of equality between the sexes this is alarming. Results from the studies performed showed some gender differences in physical capacity already among young children aged 8–12 years. Boys had better results in most of the physical tests. In these ages boys and girls are supposed to have similar physical capacity. An interesting finding was also that boys perceived their physical competence in physical education as higher than girls did. One reason for this could be that physical education is more adjusted to the boys through activity choice, with most of the time spent on ball games or other activities traditionally more associated with boys. It has been shown that girls seem to take boys' motor achievements as a point of reference (Harter, 1985; Van Dongen-Melman et al., 1993) and discount their talent when performing. This might be especially obvious when the content of physical education is more adjusted to boys. This is a matter for revision in physical education, as the education must be appropriate and developing for both boys and girls. As girls participate in less physical activity than boys do in leisure time (Hussey et al., 2001), especially in more vigorous activity (Riddoch et al., 1991), and their physical activity levels decline earlier in life (Armstrong et al., 2000), school physical education must devote special effort to the early development of girls' physical capacity as well as girls' physical self-perceptions.

Another aspect of the physical status among girls is the matter of reproduction. The adolescent girls are presumptive mothers. The conditions for their future children are important during the whole childhood, also before conception (Lundberg, 1993). Maternal overnutrition and obesity may affect levels of obesity in offspring. The energy balance for the child is important, not only from birth, but also before conception and during the foetal period (Whitaker & Dietz, 1998; Lundberg, 1993). Girls with high physical capacity, normal weight and high physical activity levels have a good chance to give their babies a good start in life. Inactive girls with low physical capacity and overweight could be seen as being at high risk of transferring the inactive behaviour to the offspring. Some factors during early childhood and/or in foetal life make a biological imprint on the human organism in a way that makes it more susceptible to illness later in life (Lundberg, 1993; Alberman et al, 1992). Children born with a genetic predisposition for obesity, and biological

imprints from environmental factors, and inactive parents as role models in the socialization process are at high risk of becoming inactive and obese themselves. The influence of parents on eating and activity behaviour is crucial (Klein-Platat et al, 2003; Guillaume et al, 1997). The continuum of physical capacity and physical activity could therefore be seen as intergenerational.

In the socialization processes habitus is developed very early in life and constitutes a system of embodied habits, dispositions and preferences, which determine the behaviour, thinking, interpretation, and valuation of the environment (Bourdieu, 1986). The taste for physical activity has social and cultural origins, and the taste is developed in the meeting between habitus and existing living conditions (Engström, 1999). Childhood obesity was shown to be strongly correlated with the mother's obesity status and the time that the child spent in physical activity (Arluk et al, 2003). School physical education plays an important role in raising the level of physical activity among children. However, young children's activity levels, as with all other behaviour patterns, are modelled on those of their parents (Simons-Morton et al, 1997; Stucky-Ropp & DiLorenzo, 1993). Active parents are more likely to have more active children (Moore et al, 1991). Children accustomed to be driven even short distances will likely not appreciate physical activity as an adult. Mothers seem to be important for children's total development and socialization into healthy behaviour. Mother's educational level, rather than the financial resources, has been suggested to affect overweight among children (Klein-Platat et al, 2003). Unfortunately, inactive behaviours adopted in childhood tend to track better than active behaviours through the transition from adolescence to young adulthood (Raitakari et al, 1994). Therefore it is important that as many young girls as possible are active to raise the activity level of adolescent girls who are presumptive mothers. In adolescence it might be too late for effective interventions. Children are not born intrinsically motivated to do different activities, but with appropriate learning experiences, almost any activity can become imbued with consuming significance. Positive incentives are often used to promote development of interest in activities for which people initially lack skills, interest and self-efficacy. This is controversial, however. For example, Deci and Ryan (1985) stated that rewarding people for engaging in an activity is more likely to reduce than to increase subsequent interest in it (Deci & Ryan, 1985). Parents are key persons who have the delicate issue to motivate their offspring to adopt active habits, and to balance the extrinsic rewards so that they will not result in the opposite reactions.

"Those who always let their children do as they like have completely misunderstood the concept of freedom. It is extremely cowardly to say to one's children: Do as you like!"

Astrid Lindgren

Girls in vocational education were educated for specific jobs, assistant nurses, food industry workers, hairdressers etc., and their educational level will be counted as low. According to previous research, it will be these low-educated girls' children that will be physically inactive and overweight. This opens up for possible interventions. One could be to raise physical skills and physical activity levels among young girls in order to improve their self-perceptions. An early intervention among young girls would hopefully increase the amount of active mothers. This investment in time and quality in physical education should comprise both girls and boys. However, swift measures must be taken on girls' physical activity out of intergenerational concern. The amount of time allotted for physical education should be expanded and sufficient to allow lessons with both boys and girls separated and together. Some gender-segregated physical education lessons a week might raise the levels of self-perceived competence among girls as they do not have to take boys' motor achievements as a point of reference. In the intervention school girls and boys were separated one lesson a week, which was perceived positively. However, further studies in this area are needed. Interventions to augment physical activity levels early in children's life through their mothers should also be emphasized in antenatal clinics, child health care, day nursery and preschools. Further research is needed to establish whether promoting physical activity in these institutions is practicable for persistent physical activity levels among children.

Among the young children the increase in BMI was slowed down in the intervention school in comparison with the norm school. A mean change in BMI ratio, calculated as the ratio between the individual BMI and the cut-off point for overweight for age and gender according to Cole et al. (2000), was 6% upwards from baseline to follow-up among all children, i.e. children in the intervention school also increased their BMI. This could be seen as an overall trend in modern society, with decreased natural physical activity and energy-dense foods. The childhood overweight and obesity epidemic is a growing problem of serious public health concern, probably one of the most important. The economic consequences of obesity are substantial. Disease risks and costs increase substantially with increased BMI. The costs for medical care and treatment are high (Thompson et al, 1999; Birmingham et al, 1999; Wang et al, 2002; Wang & Dietz, 2002; Philippas, 2005). The complexity of the problem is multifaceted with both activity and dietary aspects. The intervened dose of physical activity in our study (4×40 minutes) was probably not enough to compensate for both increased energy intake and/or lack of natural physical activity. On the other hand children's physical capacity was improved in the intervention school, which could be seen as very positive. Which school the children attended was shown to be decisive ($p=0.003$) for the positive changes in physical capacity, while the baseline BMI ratio was not ($p=0.997$), i.e. children with overweight as well as children with normal weight seemed to benefit from the increased physical education lessons. These findings suggest that action is called for, and that it could be implemented without complicated methods. The

expanded programme was four lessons a week and the increase in lessons was carried out by slight changes in allotment for different school subjects. The simple design could be carried out in any school without any increased costs.

Children in the intervention school increased their physical performance, especially in endurance running, indicating that expanded physical education could augment the aerobic fitness, also among overweight children. Endurance performance in children is significantly related to VO_2 max, which is accepted as a good reference standard of cardiorespiratory fitness (Massicotte et al, 1985) and related to more favourable cardiovascular disease risk profiles (Bergström et al, 1997; Dennison et al, 1988; Harsha, 1995; Malina, 2001; Blair, 1992; Malina, 1996; Telama et al, 1997; Baranowski et al, 1992; Torok et al, 2001; Twisk et al, 2001). An improvement in motor skills was also shown among children in the intervention school, which could be important for the self-perceptions and motivation for further physical activity (Harter, 1985; Weiss & Ebbeck, 1996). Obese children have been shown to be less physically active than normal-weight children (McKenzie, 1991; Sallis, 1991; Janz et al, 1995; Trost, 2003; Fonseca & Gaspar de Matos, 2005), which means that there are few occasions for developing skills. Low skills in themselves become demotivators, as relatively simple movements become huge challenges. High skills become motivators to conquer new challenges, which could be seen as the optimum. School physical education has the potential to reach large numbers of children and is therefore important for raising actual motor skills and fitness in children.

Several theories could be linked to the SOC concept. According to Harter's model, significant others are very important in the information on the outcomes of the activities (Harter, 1974). Individuals who perceive that they are competent are more intrinsically motivated to pursue high levels of challenge; further, they are more persistent and less anxious during their involvement (Harter, 1985). Self-perceptions and self-efficacy develop through personal experiences of success, but also from support from others, for example parents, peers, or teachers (Bandura, 1986b). Vallerand's model posits that the influence of social factors is exerted through the need for autonomy, competence and relatedness (Vallerand, 1997). High social capital, i.e. a strong sense of being able to influence one's own health and to increase the extent of leisure-time exercise, was shown to influence the individual's ability to influence determinants relevant for future health (Lindström et al, 2001). The term high social capital could be related to strong SOC. The socialization aspect is crucial in all these theories, and the self-esteem development is seen as social in origin. Self-esteem, SOC, attitudes, and hardiness are all developed in childhood and are all associated with support from significant others. The associations between SOC and attitudes to physical education were interesting findings, indicating that past experiences of physical education could contribute to the development of SOC, and that actual levels of SOC could influence the persistent attitudes to physical education and be important for lifelong physical activities.

When children are active, skills and capacity are developed, which is motivating in itself, and if the process is supported by significant others it could explain the relation between SOC and attitudes to physical activity. If children feel that they are able to manage (manageability), they are less anxious and know what the demands are about (comprehensibility), they want to continue to do the activity and find it stimulating and meaningful (meaningfulness). Those who liked physical education wanted even more hours on the schedule, but the reverse was also true, those who did not like physical education did not want it all. Those adolescents had the lowest physical capacity, and were the ones who would need to be more physically active. The negative attitudes could be due to previous negative experiences in physical education, but also due to influences from parents or peers, low physical activity level in leisure-time, low skills, low self-perceived competence etc. Adolescents with positive attitudes to physical education had higher SOC scores. Both SOC and attitudes are developed in childhood and seem to stabilize in adolescence.

Antonovsky as well as Kobasa focused on the hardiness concept, and Antonovsky related hardiness to SOC (Antonovsky, 1987). Hardiness has been defined as a personality style that enables a person to withstand and cope with stress. Exercise combined with hardy personality and social support was very effective in preserving health (Kobasa et al, 1985). Physically active adolescents with positive attitudes to physical education and high SOC scores can be thought to be both intrinsically motivated for physical activity and to have a certain level of hardiness. They do not care if they incur some pain from physical activity and do not focus on the negative aspects. Perceived enjoyment and well-being are seen as more valuable than the invested effort and occasional pain. Sport activities provided more flow experiences than more passive activities (Bidwell et al, 1997); the activities are interpreted as enjoying. At the same time, the activities that produce flow are more demanding and difficult, and could occasionally produce conditions of anxiety. This is a bargain that many people make. Is it worth engaging and investing energy to perform challenging physical activities? It might produce a pleasant feeling of flow, but it will also bring about increased risk of unpleasant feelings like anxiety. The levels of SOC among adolescents might represent the personality, together with the social influence from parents, teachers, peers, and other key people around them. The genetic disposition for physical activity or inactivity has been discussed, the rover or sitter personality. Markers in the genes of fruit flies (*Drosophila melanogaster*) have been found to be associated with either physical activity or inactivity, and there has been discussion of whether humans are predisposed for activity or inactivity in the genes in the same way as fruit flies, but no conclusion has been drawn (Wolfarth et al, 2004).

Grade in physical education was associated with SOC, whereas the average grades were not, which was an interesting finding. The grade in physical education was in turn related to self-reported physical activity; the highest grades were found among those who reported exercise four times or more per week and the lowest

among those who reported no exercise at all. The association between grades in physical education in adolescence and physical activity in adulthood has been shown in a study by Engström (1991). Tracking effects could be seen from 15 to 30 years of age and it was concluded that the indicators of physical activity at the age of 30 were: at least four hours of physical activity at age 15, being a member of a sports club at age 15, and having a high grade in physical education at age 15 (Engström, 1991). Having a high grade could be seen as having a high physical capacity and positive attitudes. Negative attitudes to physical activity in adolescence were shown to be significant determinants of adult risk factors (Barnekow-Bergqvist et al, 2001), which strongly emphasizes the importance of positive attitudes to physical activity in childhood and adolescence. Positive attitudes to physical education indicated positive attitudes in general to physical activity, and could therefore be important for lifelong physical activity. It is difficult to change attitudes, intentions and behaviours, and lots of time is needed. One hour a week is not enough to change most behaviour unless you have a very highly motivated clientele.

Difficulties in measuring physical activity are well known (Sallis, 1991; Montoye et al., 1996) and there are, of course, factors of uncertainty when young people report such complex behaviour. Self-reported physical activity is commonly used in major surveys, because of their low cost and convenience of administration. It has been suggested that physical capacity or fitness is more appropriate and objective to investigate than physical activity. Physical tests, which assessed physical capacity (physical index), were used in both Studies 1 and 2. Answers in the questionnaire were linked to the physical tests. As relations were found between the measured physical capacity and self-reported physical exercise, it can be assumed that children and adolescents had at least some sense of their physical status and of being active or not. Self-reported exercise together with measured physical tests gave valuable information on self-perceived level of leisure-time exercise in relation to actual capacity. Physical capacity (physical index) was highest among those who reported a high level of regular exercise and lowest among those who reported low doses. This could be seen among both adolescents and children. Physical capacity is related both to current physical activity levels and to a function of heredity, and the genes cannot alone be responsible for high fitness (Caspersen et al, 1985), i.e. those with high physical capacity were most likely to be physically active.

Methodological considerations

One advantage of this thesis was the low number of dropouts; among adolescents the participation rate was 85% and among children 99%. Thus the results might be generalized to children and adolescents in similar settings. In both Studies 1 and 2 physical tests and anthropometric measures were linked to questionnaires, which

gave opportunities for a wide range of analyses and conclusions. The questionnaires in both studies were carefully designed and piloted before use. Some of the questions were taken from other questionnaires with validated questions, and some of the questions were created. In Study 2 a test-retest procedure among 66 children from the study group was performed within a three-week period. Only questions with at least a moderate strength of agreement (Kappa above 0.40) according to Altman (1991) were used in the analyses. Questionnaires were distributed and surveyed when the respondents answered the questions. Both children and adolescents completed the questionnaires during school lessons and they could ask if they did not understand the questions. It was ensured that the test procedure was the same in all classes.

A limitation is that the cross-sectional study design in Study 1 does not allow causal conclusions, so the directions of causality are hazardous to define. However, the study gives valuable information on the differences in physical capacity in different groups of adolescents related to their educational programme.

Study 2 had a longitudinal design, which could be seen as an advantage. Very few intervention studies have been performed to evaluate the benefits of expanded physical education lessons. This was a three-year follow-up intervention study. Due to the aim of studying children in ordinary life it is impossible to have full control over everything that happens. However, the two schools were similar in size, conditions, and influences from society outside school, and the trustworthiness could be viewed as high. The sample of children who participated in both baseline and in follow-up was not so big and caution should be exercised about generalization. Still, the results of the intervention study indicated interesting possibilities for positive changes in children's physical status. In Paper III the design was cross-sectional as the results are based on the baseline measurement. The study highlights the interesting associations between physical activity, body composition, physical competence, motivation to perform physical activity, and self-perceived physical competence among children. Even if no conclusions about the causality could be drawn, the study gives valuable information about children's self-perceptions and the relationship to actual measured capacity.

The physical tests were taken from other studies. In Study 1 several of the tests used were validated by Bergqvist et al. (1992). To test the endurance performance among adolescents Åstrand's cycle ergometer test (1986) was used. A correlation for the age-predicted peak heart rate was made. In Study 2 most of the tests were taken from the EUROFIT test battery (1993), which has been used in several studies. Endurance performance among children was tested by a running test for six minutes, which was developed from the one-mile running test (Ezzell et al., 1991). All physical tests, in both Studies 1 and 2, were piloted before use. All students were tested by the same test leader (ACS). The test leader gave both verbal and visual instructions to children and adolescents. They did not find the tests difficult to perform and did not find the instructions difficult to understand. In Study 1 seven

physical tests were used, and in Study 2 eleven. The tests were chosen because they were possible to carry out in a field testing situation, and were supposed to give a spectrum of the students' physical capacity. Of course, students could have performed some more tests, but the tests comprised the physical qualities represented in the physical fitness definition: endurance, agility, strength, power, flexibility, coordination, and they gave a picture of the physical capacity. The anthropometric data were also collected by the same test leader.

The calculation of the physical index for each individual was done separately for girls and boys among both adolescents and children. Among adolescents there were evident differences in physical performance between boys and girls, and it was necessary to calculate separately. Also among the young children there were slight differences in performance between boys and girls, and therefore the calculation was done separately so the girls would not be disadvantaged.

Conclusions

The conclusion of this thesis is that there is a possibility to achieve improvement in physical status among young people and to slow down the increase in BMI with a modest increase of physical education lessons in school. This could be seen as important information for policy makers who must take into consideration that young people become adults who in their turn make imprints in their offspring. The findings of this thesis accordingly suggest increased time for physical education throughout the whole school system, from preschool to upper secondary school. It is urgent to raise the physical capacity in all ages, but could be seen as crucial among children and adolescents as they will become the next generation of adults. Differences in physical capacity between prospective blue-collar and white-collar workers already in adolescence during education emphasize early interventions to increase physical activity in young people. Interrelations between Sense of Coherence (SOC) and attitudes to physical education among adolescents indicate the possibility of affecting the development of SOC through positive experiences of physical education in school, which could be important for the motivation for life-long physical activity and for improved adult health status. Young active children perceived their body function as better and their physical competence as higher than less active children did, which has been shown to be a deciding factor for participation in physical activity. Physical education in the school setting could be seen as an important arena for improving physical capacity, positive self-perceptions and positive attitudes to physical activity.

Sammanfattning på svenska

De som är barn idag är nästa generation vuxna. Avhandlingen handlar om fysisk aktivitet och fysisk status hos unga individer, med framtiden i åtanke. Dagens barn skall i framtiden orka arbeta och försörja både sig själva, sina barn och den äldre generationen som vi då utgör. Under barn- och ungdomstiden utvecklas fysisk status, attityder och hälsobeteenden som har betydelse för resten av livet. Barn idag – vuxen imorgon! Barn idag – förälder imorgon!

Människan är i grunden konstruerad för att vara i rörelse stor del av den vakna tiden, men i det högteknologiska moderna samhället har den naturliga fysiska aktiviteten minskat för både barn, ungdomar och vuxna. Fysisk aktivitet, som var något livsnödvändigt för att skaffa föda och överleva, har nu blivit något som man kan välja att göra eller inte göra. Fysisk inaktivitet med ökad risk för olika sjukdomstillstånd är ett stort folkhälsoproblem, kanske ett utav de allra största.

Fysisk aktivitet förhöjer välbefinnandet och den fysiska prestationsförmågan, dvs stärker skelett, muskler och annan stödjevävnad, tränar upp koordination, balans och rörlighet, samt har också visats minska risken för sjuklighet i ett flertal kroniska sjukdomstillstånd. Individens aktivitetsnivå och fysiska status under barn- och ungdomsåren tycks ha ett samband med aktivitetsnivå och fysisk status i vuxenlivet. Under barn- och ungdomstiden skall alla vävnader och funktioner utvecklas, liksom de attityder som sedan kommer till uttryck i att ”tycka om” eller ”inte tycka om” fysisk aktivitet. Samtidigt som andelen barn och ungdomar som ägnar sig åt s k spontanidrott har minskat, har också tiden för ämnet idrott och hälsa i skolan kraftigt beskurits.

Syftet med avhandlingen var att undersöka barns och ungdomars fysiska status och fysiska aktivitetsnivå samt öka kunskapen om vilken roll skolämnet idrott och hälsa spelar i ett salutogent folkhälsoperspektiv.

Den första studien genomfördes 1996 bland 301 ungdomar som studerade på olika program i gymnasieskolan. Sex praktiska program valdes ut på grund av att de ledde till yrken med fysisk belastning: fordonsmekaniker, livsmedelsarbetare, metallindustriarbetare, byggnadsarbetare, undersköterskor, hårfrisörer. Dessa yrken har också visats ha hög prevalens av arbetsrelaterade besvär och sjukdomstillstånd. De två teoretiska programmen, samhällsvetenskapligt och naturvetenskapligt program, valdes också att ingå i studien. Totalt ingick 16 klasser från dessa åtta olika program. Resultaten baseras på enkätsvar, fysiska test, antropometriska mätningar samt studieresultat i form av betyg. Som mått på fysisk kapacitet beräknades ett fysiskt index som en summering av mätresultaten i de sju fysiska testen till ett index för varje individ, en s k Z-score, så att fördelningen låg kring medelvärdet 0 och där ett högt värde visade på en hög fysisk kapacitet och ett lågt värde på låg kapacitet.

Den fysiska kapaciteten befanns vara högre bland ungdomarna på de teoretiska programmen än på de praktiska, bland flickorna 1,51 respektive –1,24 och bland pojkar 1,11 respektive –0,46. Det innebär att de ungdomar som utbildade sig till yrken med tung fysisk belastning hade sämst fysisk kapacitet. Detta visade på en ojämlikhet i fysisk status och hälsa redan vid inträdet i arbetslivet. När de fysiska kraven är höga är det ännu viktigare att ha en god fysisk kapacitet för att klara av ansträngningen utan att skada sig. Själva upplevelsen av arbetets ansträngningsgrad är också avhängigt den egna kapaciteten. Muskuloskelettala sjukdomar har visats vara den främsta orsaken till sjukskrivningar och förtidspensioner.

De ungdomar som var fysiskt aktiva och hade hög fysisk status kan anses ha en god chans att starta arbetslivet utan komplikationer, medan ungdomar med låg fysisk status och ringa eller ingen fysisk aktivitet alls kan riskera att skadas tidigt i sitt arbetsliv på grund av en låg marginal mellan vad arbetet kräver och maximal kapacitet. Skillnaden i fysisk kapacitet var mer uttalad bland flickorna. Var femte flicka på praktiska program hade så låg syreupptagningsförmåga att de redan låg i riskzonen för hjärt- och kärlsjukdomar. En annan aspekt av den fysiska statusen hos flickorna är att de är presumtiva mödrar. Förhållanden för det ofödda barnet är viktiga under hela barndomen, även i moderlivet och före befruktningen. Fysisk aktivitet och fysisk status kan anses vara överförbara till nästa generation både via socialisation och via biologiska faktorer. Även övervikt hos mamman har visats vara överförbar till barnet.

I samma studie undersöktes känsla av sammanhang (KASAM) samt attityder till idrott och hälsa bland ungdomarna. Resultat visade att det fanns en ömsesidig relation mellan KASAM och attityder till idrott och hälsa, vilket indikerade att tidigare erfarenheter av fysisk aktivitet samt idrott och hälsa kan bidra till utvecklingen av KASAM. Nivåerna av KASAM kan också påverka attityderna till idrott och hälsa och vara betydelsefulla för fysisk aktivitet i ett livsperspektiv. En korrelation mellan studieresultat (betyg) och fysisk kapacitet kunde påvisas bland både pojkar och flickor. Ungdomarna som rapporterade högst fysisk aktivitet hade också högst kapacitet, dvs det kan anses att de var fysiskt aktiva.

Det ledde till hypotesen att om den fysiska aktiviteten kunde höjas bland barn i skolan via idrottsundervisningen, skulle den fysiska kapaciteten kunna ökas. Det ledde i sin tur till nästa studie, som var en longitudinell studie där mätningar gjordes årligen 2000–2003 bland yngre barn 6–12 år (n=205–275 barn) i två skolor. De årliga mätningarna bestod av elva fysiska test, antropometriska mätningar samt enkätundersökningar. Utifrån de elva fysiska testen beräknades ett fysiskt index som summan av de åldersstandardiserade mätresultaten i form av residualer till ett index för varje individ med medelvärdet 0, där ett högt resultat visade på hög fysisk kapacitet och ett lågt på en låg kapacitet.

Efter baslinjemätningen år 2000 startades en intervention med utökad tid för ämnet idrott och hälsa i den ena skolan, medan den andra skolan följde stipulerad tid enligt läroplanen. Antalet schemalagda undervisningspass i idrott och hälsa ut-

ökades från 1–2 lektioner till 4 lektioner per vecka, med utomhusverksamhet den femte dagen i interventionsskolan. Lektionstiden om 40 minuter var effektiv och tid för ombyte och duschning låg utanför lektionen. Undervisningen sköttes av skolans idrottslärare och klasslärare. Interventionsmodellen innebar också att kvaliteten i undervisningen poängterades samt att en lektion i veckan hade pojkar och flickor delad undervisning. I avhandlingen redovisas resultat från jämförelsen mellan barnens fysiska status i baslinjemätningen och i uppföljningen, samt en analys av barnens självskattade fysiska kompetens från baslinjemätningen.

Resultaten visade att ökningen av antalet lektionstimmar i idrott och hälsa hade en effekt på barnens fysiska status. Barnen i interventionsskolan ökade sin fysiska kapacitet jämfört med barnen i normskolan. Förändringarna var särskilt påtagliga vad gällde konditionen och motorisk skicklighet. En multipel regressionsanalys visade att vilken skola barnen gick på hade betydelse för förändringarna i fysisk kapacitet, medan deras body mass index (BMI) i baslinjemätningen inte hade någon betydelse, vilket visade att utökad tid för idrott och hälsa gynnade både normalviktiga och överviktiga barn.

En generell trend var att barnens BMI ökade med 6% under den här treårsperioden. Dock ökade inte BMI lika mycket i interventionsskolan jämfört med normskolan. Ökningen till fyra lektioner i veckan tillsammans med en timmes uteaktiviteter kan inte anses vara tillräckligt för att helt kompensera inaktiva barns låga fysiska aktivitetsnivå och ett högt energiintag. Det kan ändå ses som positivt att barnens fysiska kapacitet kunde påverkas med enkla förändringar i skolans timplan, vilket innebär att det är möjligt för varje skola att utan kostnader eller större ingrepp öka barns fysiska status och främja en positiv hälsoutveckling.

En hög självskattad kompetens i idrott och hälsa bland barnen var associerad med hög fysisk kapacitet, manligt kön, låg ålder, boende med båda föräldrarna, hög självskattad kondition samt de ansåg att idrott och hälsa var roligt. Den högsta fysiska kapaciteten fanns bland barnen som rapporterat en hög fysisk aktivitetsnivå på fritiden, dvs samma iakttagelse som kunde ses bland ungdomarna.

Sammanfattningsvis kan sägas att avhandlingen visar på en möjlighet att öka barns fysiska status och att sakta ner ökningen av BMI genom en blygsam ökning av antalet lektioner i idrott och hälsa i skolan. Detta kan ses som viktig information till politiker och andra beslutsfattare som måste ta hänsyn till att unga individer blir vuxna, som i sin tur kommer att påverka nästa generation. Resultaten från avhandlingen föreslår en generell utökning av tiden för ämnet idrott och hälsa genom hela skolsystemet, från förskolan till gymnasieskolan. Det är angeläget att höja den fysiska kapaciteten i alla åldrar och kan ses som avgörande bland barn och ungdomar som är nästa generation vuxna. Skillnader i fysisk kapacitet mellan framtida arbetare och tjänstemän redan under utbildning i skolan understryker vikten av att tidigt i barndomen öka den fysiska aktiviteten för att utjämna skillnaderna. Skolan är den samhälleliga institution där möjlighet, organisation och personal finns för att kunna ge hälsoundervisning och varierade fysiska aktiviteter, och är en viktig

arena för att nå barn från olika socioekonomiska grupper. Idrott och hälsa har möjlighet att öka barns fysiska kapacitet, positiva självskattning och positiva attityder till fysisk aktivitet, och gynna framtida hälsa.

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