## ABSTRACT

This thesis, with a national sample of Swedish school students, is part of a collaborate project between Karolinska Institutet, The Swedish School of Sport and Health Sciences and Stockholm Institute of Education carried out in 2001 and with a follow-up study in 2004.

The overall aim of the collaboration was to investigate the conditions and circumstances surrounding school children's physical activities, their physical capacity, and general heath status. The aim was further to examine medical, physiological, and social consequences of variations in physical activity level, with special attention paid to changes over time and with increase in age.

The main aim of this thesis was to study students' perceived health, pain and reported injuries sustained during physical activity, with a focus on gender and age/grade differences (Study I and II). The aim of the third study was to examine changes in perceived health with increasing age within the same individual as well as over time at grade level e.g. comparing the cohort of same school-grade with a three-year interval. In addition, the aim was to investigate if factors, such as gender, age (grade level), stress, and level of physical activity were related to perceived health (Study III). The aim of the fourth study was to compare agreement of answers, given by the students with those given by their parents, to questions addressing students´ medical background, injuries and perceived health.

An independent random selection of Swedish schools (n=48) enrolling grades 3, 6 and 9 was performed. In 2001, a total of 1,908 students participated in Studies I and II. The subjects in Study III were those school-students who participated in the base study (2001) and who subsequently answered a mailed-out questionnaire in 2004. Twelve hundred and seventy six (1,276) students participated, representing 67 % of the original subjects. The subjects in Study IV were recruited from eleven different schools and were a sub-sample of schools that participated in the base study. The students attended grade 6 during the base study and were at the time of the investigation attending grade 8. Their parents were, at the same time, contacted and 186 corresponding student-same parent answers were collected.

A special health and injury questionnaire was constructed for the purpose of the studies. Prior to its administration on the test days, the questionnaire was pre-tested for relevance and

comprehension by students of the corresponding age groups, and subsequently in a pilot study. In addition a reliability test, using a one-week test-retest procedure was performed.

Every sixth student (n=299 or 16 %) reported an injury during the recall period (Study I). The most common type of injury was a sprain, sustained through a fall or a twisting movement. The lower extremity was the most frequently injured body site. There was a gender difference in injuries reported during physical education class, an age difference during organized sports but no age or gender differences during leisure activities. Every other student (50 %) reported that they previously had injured the same body part. Injuries sustained during physical activities were common, which accentuates the importance of guidelines for injury prevention and safety education programs in schools.

Fifty percent of the students reported that they had experienced pain, either as headache, abdominal pain or musculoskeletal pain, within the recall period (Study II). Gender differences were especially noticeable for headaches. Co-occurrence among the variables was moderate. For the total of the seven variables, the perception of pain and health complaints decreased with age for boys from grade 3 to 9, while multiple complaints increased for girls.

Results from the follow-up study (2004) showed for girls a continuing increase of frequent complaints over the three year period (Study III). In contrast, boys reported a decrease with the exception of tiredness, which increased with age for both genders. More girls (12 %) than boys (4 %) reported frequent pain at both measurement periods. When comparing change in assessment at grade level most variables were rated the same as three years earlier. Prevalence as well as change in prevalence of frequent complaints of pain and perceived health were related to gender and increasing age. Jointly, significant predictors, such as stress, gender, being physically inactive, and grade level explained 8-20 % of the frequent complaints. Stress as an explanatory factor for pain and health complaints was especially significant for girls and the risk of complaints, as calculated with odds ratio, was most evident for students who were characterized as being physically inactive in 2001 and remained inactive three years later.

Once a child is in good health, in absence of disease, pain and injury, his or her assessment matches up with their parent (Study IV). Children and parents also showed agreement in cases of severe injuries and daily complaints of knee pain. Less frequent headaches, back- and musculoskeletal pain and other complaints of minor injuries and tiredness, were all under-

reported and under-rated by their parents. This suggests that when assessing the perceived health and well-being of students, their own expressions should be the basis for the data collection and analysis rather than relying entirely on parental reports.

**Keywords:** Abdominal pain, child-parent agreement, headache, leisure activities, musculoskeletal pain, organized sports, perceived health, physical education class, school children, sports injury, stress.

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## SVENSK SAMMANFATTNING (SWEDISH SUMMARY)

**Introduktion:** Denna avhandling som baseras på ett nationellt urval av svenska skolbarn, är en del av ett omfattande tvärvetenskapligt forskningsprojekt, Skola Idrott och Hälsa (SIH), som är ett samarbetsprojekt mellan Karolinska Institutet, Gymnastik och Idrottshögskolan samt Lärarhögskolan i Stockholm. Studierna som ingår i projektet genomfördes mellan åren 2001 och 2004.

Syftet med SIH projektet har varit att få ökad kunskap om sambandet mellan barns levnadsvanor, fysiska status, och hälsa.

Syftet med avhandlingsarbetet har varit att kartlägga och analysera skolelevers självrapporterade upplevda hälsa, värk och skador, med speciellt fokus på ålder och könsskillnader. Ett ytterliggare syfte har varit att studera elevernas individuella förändring över en treårsperiod samt om årskurs 6 och 9 år 2004 beskrev samma hälsoläge som årskurs 6 och 9 år 2001. Dessutom studerades med multivariat logistisk regressionsanalys om kön, ålder, självskattad stress och fysisk aktivitetsnivå var relaterade till elevernas upplevda hälsa. Att undersöka överensstämmelsen mellan elevers och deras föräldrars uppgifter om de förras medicinska bakgrund och hälsotillstånd var syftet med den fjärde studien i avhandlingen.

**Material**: Ett oberoende slumpmässigt urval av skolor (n=48) med årskurs 3, 6 och 9 från hela Sverige utfördes av Statistiska Centralbyrån. I basstudien år 2001, som är grund för studie I och II, deltog 1908 elever. Eleverna i studie III var de elever som deltog i basstudien och som dessutom besvarade en hemskickad enkät år 2004. Antalet elever var 1276, vilket var 67 % av ursprungspopulationen. Eleverna i studie IV (år 2002) kom från ett mindre urval av skolor (n=11) som besöktes av forskargruppen. Elever (n=232) ur årskurs 8 samt deras föräldrar (n=200) besvarade separat en enkät. Ett hundra åttiosex matchande elev-förälder enkäter insamlades.

**Metod:** Eleverna besvarade en enkät, som var konstruerad för det aktuella projektet. Enkäten var av allmän medicinsk karaktär och innefattade frågor om upplevt hälsotillstånd och idrottsskador. Enkäten hade först testats på barn i motsvarande åldrar samt i en pilotstudie. Därutöver genomfördes en reliabilitetstest av enkäten.

**Studie I**

**Titel: Injuries during Physical Activity in Swedish School Children**. Sundblad G, Saartok T, Engström L-M, Renström P. Scand J Med Sci Sports 2005; 15: 313-323.

**Syfte:** Beskriva skademönstret hos de båda könen och mellan olika åldersgrupper (9, 12 och 15 år) under olika fysiska aktiviteter.
**Metod:** Eleverna besvarade en enkät och rapporterade inträffade skador retrospektivt (3 mån). Skadan och omständigheter vid och efter skadetillfället diskuterades med testledaren.
En skada definierades som en extern traumatisk händelse, vilken föranledde att aktivitet måste avbrytas och att skadan krävde ett medicinskt omhändertagande av lärare/skolsyster/annan vuxen/tränare och/eller läkare inklusive tandläkare.
**Resultat:** Var sjätte elev (n=299) rapporterade att de hade råkat ut för en skada eller ett olycksfall under skol- och/eller fritid de första 10-14 veckorna av vårterminen 2001. Den vanligast förekommande skadan var en stukning eller sträckning, orsakat av ett fall eller vridrörelse. Framförallt hade eleverna skadat de nedre extremiteterna. Dubbelt så många flickor som pojkar hade skadat sig under idrottslektionerna och då oftast under bollspel. Det var vanligare att elever ur årskurs nio skadades under organiserad idrottsträning jämfört med de yngre årskurserna. Däremot förekom det inga köns- eller åldersskillnader vad beträffar förekomst av skada på fritiden. Varannan elev (50 %) rapporterade att de hade skadat samma kroppsdel tidigare. Skador uppkomna under fysisk aktivitet var vanligt förekommande men majoriteten av skadorna var lindriga och eleverna kunder åter delta i fysisk aktivitet efter en vecka. Studien visade på vikten av idrottsmedicinsk utbildning av idrottslärare, tränare och skolsyster då dessa yrkesgrupper var de som framförallt genomförde det akuta omhändertagandet av eleverna vid skadetillfället.

**Studie II**

**Titel: Prevalence and co-occurrence of self-rated pain and perceived health in school children; Age and gender differences.** Brun Sundblad G, Saartok T, Engström L-M. Eur J of Pain, Epub ahead of print, March 2006

**Syfte:** Huvudsyftet var att utvärdera prevalens av självskattad värk och upplevd hälsa med fokus på köns- och åldersskillnader. Ytterliggare syfte var att studera om det förekom samvariation mellan de olika värk och hälsovariablerna.
**Metod:** Som ett mått på elevernas upplevda värk och hälsa fick de i enkäten skatta hur ofta de hade eller hade haft huvudvärk, magont och ont i kroppen sedan terminen startade (3 mån).

Eleverna skattade även hur ofta de upplevde sig ha problem med att sova och om de kände sig trötta, ensamma och ledsna. Alternativen skattades på en femgradig sk Likertskala.
**Resultat:** Hälften av eleverna uppgav att de hade haft värk i form av huvudvärk, magont eller ont i kroppen under tidsperioden. Könsskillnader var markanta för bla. huvudvärk, dagligen till minst en gång i veckan, vilket rapporterades av dubbelt så många flickor (17 %) som pojkar (8 %). Samvariationen mellan variablerna var måttlig. Totalt för de skattade sju variablerna så minskade förekomst av värk och upplevd ohälsa för pojkar mellan årskurs 3 och 9 medan förekomsten ökade för flickorna.

**Studie III**

**Titel: Self-rated pain and perceived health in relation to stress and physical activity among school-students; *A 3-year follow-up*** Brun Sundblad G, Jansson A, Saartok T, Renström P, Engström L-M. Submitted to Pain in May, 2006.

**Syfte:** Syftet med den longitudinella 3-års uppföljningen var att studera förändring över tid med ökad ålder hos samma individer och deras skattning av värk (huvudvärk, magont, ont i kroppen) samt upplevd hälsa (problem med att sova, trötthet och om de ofta kände sig stressade, ledsna och ensamma). Ytterligare syfte var att studera förändring över tid för årskurs 6 och 9 tre år senare. Vidare undersöktes om kön, ålder, upplevd stress och fysisk aktivitetsgrad var relaterade till upplevd hälsa.
**Metod:** Under våren 2004 genomfördes en upprepning av enkätundersökningen på de elever som deltog 2001. Sextiosju procent besvarade enkäten vid uppföljningen. Enkäten var med några få förändringar densamma som år 2001.
**Resultat:** Elevernas svar visade på en fortsatt ökning av självskattad värk och upplevd ohälsa bland flickor efter tre år. Pojkar rapporterade färre besvär med undantag av trötthet som ökade för båda könen med ökad ålder. Fler flickor (12 %) än pojkar (4 %) beskrev värk varje vecka till dagligen båda åren. Över hälften av flickorna (56 %) och två tredjedelar av pojkarna (67 %) uppgav inga problem vare sig år 2001 eller 2004. Det var ingen skillnad i skattning av upplevd hälsa mellan årskurs 6 och 9 år 2001 och motsvarande årskurser 2004. Att känna stress dagligen till varje vecka var signifikant relaterat till värk och skattad ohälsa bland flickor. De elever som var fysiskt inaktiva både år 2001 och 2004 rapporterade i större omfattning värk och upplevd ohälsa än de fysiskt aktiva eleverna.

**Studie IV**

**Titel: A valid question and a reliable answer; A child - parent agreement study**

Brun Sundblad G, Saartok T, Engström L-M. Submitted to BMC Public Health in June 2006.

**Syfte:** Syftet var att jämföra svar mellan barn och förälder på frågor som berörde elevernas medicinska bakgrund och upplevda hälsa med fokus på huvudvärk, ont i kroppen och trötthet.
**Metod:** Under hösten 2002 genomfördes en uppföljande studie, med ett riktat urval av de fysiskt mest respektive minst aktiva eleverna från basstudien. Forskargruppen reste runt i landet och besökte eleverna i deras skolor. Elever ur årskurs 8 samt deras föräldrar besvarade separat en enkät.
**Resultat:** Vid frånvaro av värk och upplevd ohälsa överensstämde svaren mellan barn och förälder. Man var även överens vid allvarliga skador och daglig förekomst av knäsmärta. Däremot underrapporterade och underskattade föräldrarna barnens huvudvärk, ryggont och övrig värk i kroppen samt mindre allvarliga skador och trötthet.

**Konklusion:**
Hos detta nationella urval av svenska skolbarn var könsskillnader signifikanta vid skador under idrottslektionen. Likaså fanns säkerställda åldersskillnader i skaderapportering vid organiserad idrottsaktivitet. Däremot fanns inga köns- eller åldersskillnader i skadefrekvens under fritiden. Förekomst av värk och upplevd ohälsa samt förändring i dessa hänseenden, var under en tre års period relaterade till kön och ålder. Den skattade ohälsan var också relaterad till upplevd stress och fysisk inaktivitet. Skolelevers egen skattning av värk och upplevd ohälsa bör ligga till grund för åtgärder av olika slag och också för framtida studier av barn och ungas hälsotillstånd

**Nyckelord:** Elever, fritid, föreningsidrott, huvudvärk, idrottslektion, magont, ont i kroppen, skador, stress, upplevd hälsa, överensstämmelse mellan barn och förälder.

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## LIST OF ORIGINAL PAPERS

This thesis is based upon the following original papers, which will be referred to in the text by their Roman numerals (Studies I-IV).
In addition, some hitherto unpublished results are presented.

**I.** **Injuries during physical activity in school children.**

Gunilla Sundblad, Tönu Saartok, Lars-Magnus Engström, Per Renström
Scand J Med Sci Sports 2005; 15: 313-323

**II.** **Prevalence and co-occurrence of self-rated pain and perceived health in school children, Age and gender differences**

Gunilla Brun Sundblad, Tönu Saartok, Lars-Magnus Engström
Eur J of Pain, Epub ahead of print, March 2006

**III**. **Self-rated pain and perceived health in relation to stress and physical activity among school-students; A 3-year follow-up.**

Gunilla Brun Sundblad, Anna Jansson, Tönu Saartok, Per Renström, Lars-Magnus Engström
Submitted to Pain, 2006

**IV.** **A valid question and a reliable answer, A child-parent agreement study.**

Gunilla Brun Sundblad, Tönu Saartok, Lars-Magnus Engström
Submitted to BMC Public Health, 2006

## DEFINITIONS

**Injury setting:**

Students reported injuries that had occurred at school during physical education class, during breaks or when traveling back and forth to school. Leisure time injuries occurred during free play activities in contrast to injuries sustained during organized sports, when the student was under the supervision of a trainer or a coach.

**Pain:**

Pain was defined in the surveys as a constant or recurrent sensation not attributed to an injury/accident, or to their knowledge, a medical disorder. The school children reported prevalence of abdominal pain, headache, back-, and musculoskeletal pain.

**Physical activity:**

Physical activity (PA) is according to Caspersen et al., (1985) defined as "Any bodily movement produced by skeletal muscles and resulting in energy expenditure".
In our study, level of physical activity was assessed through a wide range of questions addressing the frequency, intensity, and regularity of the school children's physical activities.

**Recall period:**

The school children were asked to recall injuries, pain, and perceived health since the onset of the spring term, i.e. early January until the testing period, in March/April. Thus the recall period for the students was 10-14 weeks.

**Reliability:**

Reliability is associated with the accuracy, consistency as well as the repeatability of a test e.g. questionnaire.

**School children and students:**

Childhood refers to the period until the start of puberty, whereas adolescence denotes the period that starts with puberty and ends with adulthood. At the time of the base study, the participating students were of age 9, 12 and 15 years at the onset of the year. They were referred to, as a group, as school children, school-age children, and sometimes adolescents. Thereafter with their increasing age, they are in the later studies referred to as adolescents and students. However, in

the child parent agreement study they are both referred to as students and children depending on if viewed as a group or depicting the relationship with their parent or legal guardian.

**Self Rated Health (SRH):**

School children's assessments of how often they had problems sleeping, felt tired, stressed, sad, and lonely, in addition to their perceived pain (abdominal pain, headache and musculoskeletal pain) were in the studies regarded as a measurement of their SRH.

**Sports injury:**

An injury was defined as a traumatic incident, during physical activity at school or during their leisure time, that made them interrupt their activity and seek medical attention by an adult, such as a physical education teacher, trainer, parent, school nurse, doctor, and/or dentist.

**Stress:**

The term was not specifically or further defined to the students. Their own appraisal and experience of stress was assessed.

**Validity:**

Validity is to confirm the relevance of the measurement technique for its objectives.

# INTRODUCTION

**Physical activity for better and for worse**

Children have engaged in physical activity and games (sports) from time immemorial. They participate in sports for various reasons and in various ways, most often because they want to have fun, be with friends, learn new things and/or engage in something they are good at. To compete and win is less important for the very young athlete according to several surveys (Landry, 2000).

Physical activity (PA) is a physical and physiological phenomenon as well as a behavioural one. It is often defined and cited as: "Any bodily movement produced by skeletal muscles and resulting in energy expenditure" (Caspersen et al., 1985). It encompasses the duration, frequency, and intensity of the activities and the units by which such movements are measured are power or work. A wide range of activities are included in the concept of physical activity, such as exercise, sport, leisure activities, transportation etc., which therefore makes it a challenge to accurately capture.

At younger ages the physical activities of children are pre-dominantly free play activities, school physical education lessons and non-organized sports activities. As they grow older they move away from free play and get involved in organized sports activities. Also with increasing age, and especially for boys, winning and competing become central, whereas achieving personal goals mainly inspires girls (Landry, 2000).

Today, there are frequent reports and discussions in the mass media and in scientific literature over the concern that children and adolescents in the industrial world are becoming less physically active and are early on adopting a sedentary lifestyle introduced by television and the abundance of electronic entertainment on the market. At the same time there is also the concern that for some very active young athletes, having training sessions at an elite level, this possibly introduces the risk of negative health consequences.

Another area of concern is the evidence of an increase in prevalence of pains, somatic complaints, depressions, eating disorders, obesity and allergies among school children, compared to figures years ago (Brattberg, 1994; Danielson, 2000; McGrath et al., 2000; Fichtel et al., 2002; Hakala et al. 2002; Clausson et al., 2003; Petersen et al., 2003; West et al., 2003; Roth-Isigkeit et

al., 2004). Similar reports of psychological distress, including stress related symptoms, headaches and sleeping problems among young adults (ages 15-24) was recently highlighted in The Swedish Government Official Reports (SOU utredning) (Bremberg, 2006).

Knowledge about the actual relationship between children's and adolescents´ physical activities, their physical status and well-being is still scarce. In addition there is a lack of knowledge regarding the impact of perceived health and pain in relationship to levels of physical activity and stress on children and adolescents (Goodman et al., 1991, 2005; McGrath et al., 2000).

The idea of a multidisciplinary study to increase our understanding of the matter was initiated by a group of professors at the Karolinska Institute and The Swedish School of Sport and Health Sciences (GIH) in Stockholm, Sweden. The working name and the unifying name of the various research parts within this collaborative study was at first "the School-project", but later, the project was renamed to the "School-Sport-Health" (SSH) project (in Swedish: "Skola-Idrott-Hälsa", SIH projektet).

Despite the popularity of physical activities among schoolchildren, too many give it up at too young of an age. According to Harris (2000), 75 % of all fifteen year olds who used to be active members of sports clubs have quit. Increasing demands and sometimes unrealistic pressure from parents and coaches and even exclusions of "unskilled" athletes or getting cut from the team are reasons why children no longer can or otherwise want to participate. Additional quoted reasons are lack of time, the burden of school work, friends, and other concurring interests. Remaining or recurrent problems after a sports injury, sometimes even multiple injuries, are causing others to drop out.

Consistent with both national and international reports, approximately half of the injuries sustained by school-aged children occur when physically active during sports or free play (Abernethy et al., 2003a; EHLASS, 2003). In a traumatic (incidental) injury, an accident or external force is involved in the injury mechanism, whereas a stress (overuse) injury results from a repeated mechanical overload in the affected tissue when physical activity is practised to extremes, beyond physical capacity and, without adequate recovery time (Micheli, 2000; Adirim et al., 2003).

**Risk factors for injuries to the young athlete**

Multiple factors, intrinsic (individual, biological, physical and psychosocial characteristics) and extrinsic (environmental and independent of the injured person and principally related to the type of activity during the incident of injury) will affect the individual at any given time. Intrinsic risk factors may possibly predispose an athlete when exposed to extrinsic risk factors, thereby becoming an athlete at risk for an injury. The risks are unique to the individual and to the specific activity or sport that the individual is engaged in (van Mechelen, 1997; Micheli et al., 2000).

Emery (2005) conducted an extensive electronic database review of literature on paediatric sports injuries and the most often identified and recognized risk factors were a) *A previous injury;* which is also the most quoted risk factor for all athletes, regardless of age (Ekstrand et al., 1983), b) *Age*; the rate and severity of children's injuries increase with age. The relative risk of sports injuries at different age groups is not known generally though the peak injury rate for girls is often quoted at 13-14 years and for boys at 15-16 years (Zaricznyj et al., 1980; Abernethy et al., 2003a), c) *Sport specificity*; each activity or sport that the child engages in poses its unique stress and distinctive risk factors which must be recognized. The extent of involvement i.e. increased level of participation and high risk sports increases the risk (Backx, 1989; Williams et al., 1998; Jones et al., 2001; Michaud et al., 2001), d) *Psychosocial factors*; the personality of the child including factors as degree of recklessness, anxiety, and self-esteem may be a risk factor (Gould et al., 2000). The inexperienced young athlete is also often unable to assess risk. Setting realistic goals may be difficult for the inexperienced young athlete, who is easily influenced by pressure from the trainer/coach, peers, and parents. Realistic goals are motivating but if goals surpass ability, skill and even their possible developmental stage, the results are counteractive and stressful for the child (Marsh et al., 1999; Micheli, 2000), e) *Decreased strength and endurance*; Aerobic fitness and muscular strength, i.e. being in good physical condition, is an important component for avoiding sports injuries (Peterson et al., 2001). Watson (1984) related lack of fitness as a major contributing factor for injuries in a study of 6,799 school children. Inadequate physique for the task causes tiredness. Any of the symptoms of tiredness and feeling exhausted, such as impairment of perception, concentration and motivation may contribute to less attention, performance, and motor control in physical activities, possibly increasing the risk for an injury.

Certain risk or causative factors are, as previously mentioned, well recognized and especially within an adult population. Many of these risk factors are shared by the adult and young athlete.

However, the uniqueness of the growing individual must be accounted for, as expressed by the often quoted expression: "Children are no small copies of adults" (Marsh et al., 1999).

The most repeatedly recommended preventive measures to young athletes are: providing adequate training, use of protective equipment, and education in injury avoidance (Zaricznyj, 1980; Adirim et al., 2003; Emery, 2005). Furthermore, The American College of Sports Medicine lists the following recommendations and preventive measures especially for youth sports (Micheli et al., 2000):

- Emphasize general fitness and exercise, not exceeding a 10 % increase in amount of training per week.
- Avoid specializing in one sport.
- Allow children to play. Intensity of the activity is better controlled by the child than parents or coaches.
- Modify adult rules to be suitable for children and make sure they are strictly enforced.
- Modify parental and coaches emphasize on winning.
- Group whenever possible by age, size, and skill.

According to Micheli et al. (2000), as many as half of the injuries sustained during organized sports, could have been avoided if proper preventive measures had been taken. An example of such a measure, i.e. a specially developed preventive training program including warm-up exercises, technique, balance as well as strength and power training, was recently conducted and evaluated by Olsen et al., (2005) in a cluster randomised controlled trial. Their conclusion was also that half of the injuries sustained are avoidable with preventive measures. Micheli et al., (2000) states that further and improved epidemiological surveillance systems for youth sports injuries are highly recommended. Thereafter, interventions and measures to avoid injuries should be implemented and later evaluated in the same manner as the initial step (van Mechelen, 1997).

One conclusion brought forward by Emery (2005), after critically examining information on risk factors and preventive strategies in youth sports, was that since injuries are increasingly common, future prospective studies of preventive measures should also look at the public health impact of youth sports injuries. These injuries are indeed an adverse effect of physical activity but do not outweigh the accompanying health problems associated with a sedentary lifestyle. Therefore, perhaps even more important for the public health impact are both the short and long term effects of physical inactivity on children's and adolescents' health.

Knowledge of what factors influence physical activity as well as inactivity is also important from a public health standpoint and with regard to strategies to promote physical fitness. It is especially important when presenting activities and organizing opportunities, and when providing availability of facilities thereafter. Whether one is physically active or not is dependent on many factors, individual, social and environmental within the culture (Engström, 1999; Sallis et al., 2000a). Gordon-Larsen et al. (2000) have shown in a US national study of nearly 20,000 adolescents that physical activity and inactivity were influenced by different motives and factors, environmental and socio-demographic, respectively.

Indeed so far, there is no prospective work that can link health in adult years with a childhood activity pattern with any degree of certainty. However, today there is a consensus and ample evidence supporting the view that physical activity is linked with improved physical fitness, health, and psychological well-being. Moreover, being physically active has a positive influence on health related behaviour, weight and various medical disorders such as hypertension, type II diabetes, osteoporosis, certain kinds of cancer and cardiovascular diseases ( US Dep of Health and Human Services, 1996; Ekblom et al., 2000; Aarnio et al., 2002; Kirkcaldy et al., 2002; Brosnahan et al., 2004; Pedersen et al., 2006). Nicoloff and Schwenk (1995) have reported that exercise is just as effective as psychotherapy and antidepressant therapy in the treatment of major depression. Other studies have also verified less depression among physically active adolescents (Sallis et al., 2000a) and adults (Hassmén et al., 2000).

Existing research findings suggests, and most researchers agree, that physical activity on a regular basis, if adapted and conducted on the terms of the child, is beneficial and important for optimal growth, can increase mineral bone density, and has a favourable effect on metabolism (Landry, 2000; Valdimarsson et al., 2006). Furthermore, it increases the child's physical capacity as well as it improves their balance, co-ordination, and motor-skills, of which the latter is considered a lifelong investment (Andrén-Sandberg, 1998; Adirim et al., 2003). Through a confident and encouraging environment the child also learns social skills and self-discipline, and develops self-esteem (Landry, 2000; Bernhardt, 2001; Adirim et al., 2003) or as phrased by Landry (2000, p6) "…activity helps them (children) develop their full genetic potential".

**Perceived health**

The years prior to the onset of puberty are generally perceived as very positive among school children (Danielson 2000). However, the school-age years are also a period of many changes in

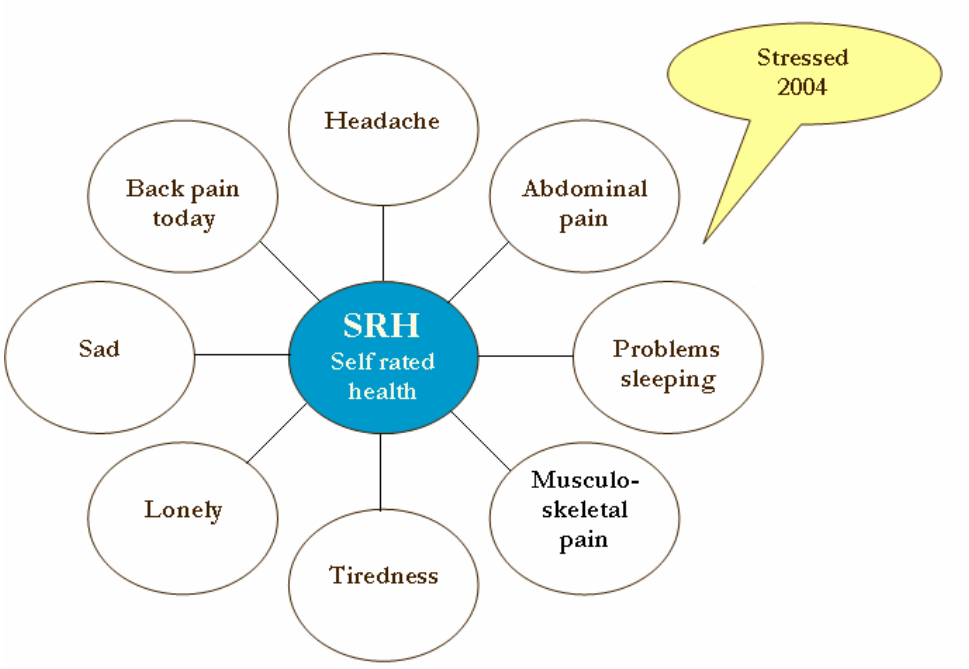
and around the growing and maturing child; physically, psychologically, emotionally, socially and with respect to their behaviours, which can be stressful. These changes inevitably affect their perceived health, especially when encountering difficulties in transitions toward young adulthood (Coleman et al., 1990).

The definition of health, well-being and pain is subjective in nature and the methods to measure and evaluate depends on the perspective taken, i.e. from a professional medical standpoint, an environmental view with a focus on risk factors and their consequences or from the individual's own perspective (Jakobsson et al., 1991). The latter represents the perspective taken in this thesis, and is directed toward an age group not normally included in this type of report.

The subjective assessment of self rated health (SRH) is both a broad and a dynamic multi-dimensional concept and often defined as the assimilation of various components of health into a meaningful whole. The perception comprises medical, physical, psychological, emotional, and psychosocial health, experienced at any level of health or illness (Mahon et al., 2005; Zullig et al., 2005). It is further culturally and socially context dependent (Luborsky, 1995; Schwarz, 2003).

SRH in adults is often assessed by a single question; "In general, how would you rate your health?" with response options ranging from "poor" to "excellent". Perceived health status rated by youth is often assessed by questions addressing frequency and intensity of a variety of measures, such as abdominal pain, headaches, fatigue, and which thereafter is summarized as their appraisal (Boardman, 2006) see Fig 1.

**Figure 1** Self rated health.



The SRH is the unique perception of the individual and is more comprehensive and holistic than strict biomedical assessments generally performed by doctors and/or other health-care professionals. Medical methods like blood pressure or tests screening for high levels of cholesterol may be scientifically correct and objective but they do not reveal the whole picture (Vingilis et al., 1998). The SRH is an excellent complement to these tests, and an important one, because no matter what the medical history is, the individual's own rating of health has in extended research proven to be a valuable predictor of morbidity, healing, and care seeking behaviour and even mortality among elderly people (Mossey et al., 1982; Idler et al., 1997; Benyamini et al., 2000; Fayers et al., 2002). The SRH rating can be used not only as a risk-screening for individuals but also as an outcome measure in clinical trials (Benyamini et al., 2000; Fayers et al., 2002). Furthermore, what makes SHR such an interesting phenomenon is that it appears to be a rather stable subjective perception contrary to measured objective health status (Mossey et al., 1982). This is a puzzling fact since subjects themselves state they rate "day by day" without pattern. According to Krause (1994) and Zullig et al. (2005) children and adolescence use a different frame of reference (health and risk behaviours) when rating their health compared to adults. In addition, when adolescents rate their health their mental state is more significantly related to their assessment than their physical. Similar to adults, their assessment has also been found to be moderately stable i.e. an enduring self-concept (Boardman, 2006).

**Pain**

The International Association for the Study of Pain's (IASP) subcommittee on classification defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (Merskey, 1986, 1994). Inherent in the definition is that it is, just as SRH, multifactorial and complex. Pain is also a unique individual perception, with varying causes, characteristics, and consequences. Pain can be categorized as physiological, psychological, and/or behavioural with sensory, emotional, as well as cognitive components, acting, and interacting with socio-cultural and environmental factors (Committee on Psychosocial Aspects of Child and Family Health, 2001). Past experiences of pain and pain memories are important and it is often hard to distinguish between pain and anxiety (McGrath, 1994; Singer et al., 2002).

Common causes for pain in children are trauma from an accident and sports injuries, medical disorders (invasive infections, malignancy, joint-, neurovascular- and systematic-disorders) and procedure related pain as well as of idiopathic and psychogenic origin (Abu-Arafeh et al., 1996;

Committee on Psychosocial Aspects of Child and Family Health, 2001). The perception comprises a sensory part with the neural pathways reacting to noxious stimuli in addition to an affective and complex response part which is immensely context dependant (McGrath, 1994; McClain, 2002). Reporting pain is furthermore modified by the individual, research method applied, the given situation and other circumstantial facts (Anand et al., 1996).

Pain can be assessed with various methods, although self-report is considered to be the most applicable technique for children not younger than five (Manne et al., 1992; McGrath et al., 2000; Committee on Psychosocial Aspects of Child and Family Health, 2001; McClain, 2002 Singer et al., 2002) albeit possible even for 3 year olds to report location and severity of pain, according to Morton (1999). In a study conducted by Zonneveld et al. (1997) children's recollection of pain intensity showed negligible diminution over time. Younger children and children with developmental disabilities may be assessed with other means such as observations of behaviour or a choice of physiological instruments measuring heart rate, blood pressure, serum cortisol concentrations, sweating etc. However, these latter parameters may also be influenced by other states unrelated to pain, such as stress (Morton, 1999; Committee on Psychosocial Aspects of Child and Family Health, 2001; Singer et al., 2002; McClain, 2002).

Stress is another complex phenomena and a common definition of stress includes the notion that demands and expectations exceed perceived personal resources which therefore endangers well-being (Lazarus et al., 1984; Smith et al., 1998). Some stress is normal and avoidable, but in excess and when perceived in a situation as overwhelming or out of control the stress becomes a distress. The impact of the stress depends on the individual's personality including one´s skill or style to cope with it (Bremberg, 2006).

The co-occurrence of perceived stress and headache has long been acknowledged (Passchier et al., 1985), and that dissatisfaction and despair can be manifested in pain by means of stress as reported by Bandell-Hoekstra (2000). School-related stress from academic pressure and class room disturbances, and how this influenced level of health complaints was discussed by Torsheim and Wold (2001) and in a recent report by Bremberg (2006).

The socioeconomic and technological developments in the post modern age have changed the need from basic survival to a point where people have become accustom to a higher standard of well-being. Medical services, e.g. providing vaccinations and examinations for school children

have been a "tradition" since the 1800´s in Sweden. Youth health risk behaviour during the 1960´s led to a focus on health promotion in schools, which showed good results (Berg-Kelly, 2003). However, economic savings and cut backs in health services at school during the past twenty years are worrying facts reflected in reports showing again a change in health related behaviours and an increase prevalence of alcohol, tobacco and illicit drug usage (Berg-Kelly, 2003) as well as the earlier mentioned increase in pain reports.

Previously in Sweden, studies have been published with data from regional surveys and with specific topics such as injuries within certain sports, certain pain sites as headache or back pain. Up to now, there has not been such a broad study as the one carried out by the SSH group investigating perceived and general health, physical activity and fitness among a national sample of school children.

## AIMS

The overall aim of the SSH-project was to investigate the conditions and circumstances surrounding school children's physical activities, their physical capacity, and general heath status. In addition, the aim was to examine medical, physiological, and social consequences of variations in physical activity level, with special attention paid to changes over time and with increase in age. The main aim of this thesis was to study students' perceived health, pain and reported injuries sustained during physical activity, with a focus on gender and age/grade differences.

**The specific aims of this thesis were:**

**Study I:** The aim was to collect and evaluate self-reported injuries and associated factors that occurred in Swedish school children during a three-month recall period, at ages 9, 12 and 15 at the onset of the year, for both genders, and during various physical activities.

**Study II:** The main aim was to assess the prevalence of self-reported pain and perceived health complaints, from the same three-month recall period as in Study I, for girls and boys separately and at different ages.
A second aim was to study the co-occurrence among the different pain and health variables.

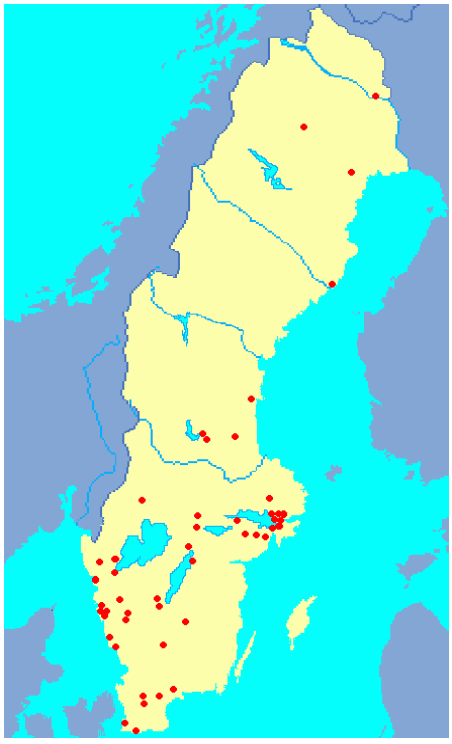
**Study III:** The first aim of this three-year longitudinal study was to assess changes in self-reported frequent pains and perceived health collected from the same students who participated in the base study (2001).
A second aim was to identify changes over time at grade level, e.g. comparing the cohort of same school-grade with a three-year interval.
In addition, the aim was to investigate if factors, such as gender, age (grade level), stress, and level of physical activity were associated with reports of frequent pain and perceived health complaints.

**Study IV:** The aim was to study the degree of agreement between students´ and their parents´ responses to questions in the health questionnaire that addressed students´ medical background, injuries and perceived health with specific focus on frequency of headache, musculoskeletal pain, and tiredness.

## SUBJECTS

In year 2000, The Swedish Bureau of Statistics was contacted and asked to perform an independent random selection of schools enrolling grades 3, 6 and 9 (students at ages 9, 12 and 15 at the onset of the year) from all over Sweden. The number of schools was selected based on our initial aim of obtaining a study population exceeding 2,000 subjects. This number was chosen for practical reasons and to enable subgroup analyses by, for example, age and gender. In reality, some of the randomly selected schools, especially in less populated areas, had very few students per class. Therefore, from the initial selection, a stratified random selection was performed so we would receive a comparable number of students representing the different grades.

A total of 58 schools, from both rural and urban areas, were contacted with a letter outlining the study, and this first contact was followed up by a telephone call. A positive response to take part was received from 48 schools. Those schools who declined (n=10) did so due to logistical constraints and other unfeasible circumstances (e.g. small countryside schools with only two to seven students meeting the inclusive age criteria (n=6), two schools that only listed students temporary for scholastic assistance and support and replacement of class teacher (n=2). For the geographical distribution of participating schools see Fig 2. From the 48 schools, 79 classes with students representing grades 3, 6 and 9 participated. All students attending these three grade levels from the selected schools were invited to participate and no students were for any reasons excluded.



After the initial contact the principal of the school, the class teachers and the physical education teachers as well as the students and their parents received information about the research project. This information included statements saying that the student's individual participation was of a voluntary nature, and could be discontinued at any given time and that the students (via coding) would remain anonymous throughout all stages of the project.

**Figure 2** Location of participating schools throughout Sweden

A total of 1,975 students participated in at least one part of the base study (Table 1).

**Table 1** Number of participants in 2001 and 2004.

| **Grade** | **3** | | **6** | | **9** | | **Total** | | **Total** |
|---|---|---|---|---|---|---|---|---|---|
| **(in 2001)** | | | | | | | **split for gender** | | |
| Gender (n) | Girls | Boys | Girls | Boys | Girls | Boys | Girls | Boys | Girls/Boys |
| 2001 | 255 | 305 | 347 | 352 | 329 | 320 | 931 | 977 | 1,908 |
| **2004** | **191** | **220** | **263** | **239** | **197** | **166** | **651** | **625** | **1,276** |
| % of 2001 | **75 %** | **72 %** | **76 %** | **68 %** | **60 %** | **52 %** | **70 %** | **64 %** | **67 %** |

The drop out rate of students from the participating schools was 12 % (n=274) and the reasons were incidental disease (4 %), the student refrained (1 %) unknown (6 %) and miscellaneous (1 %) (Table 2).

**Table 2** Drop out of students from the participating schools in the base study (2001) in percent (%).

| | **Grade 3** | | **Grade 6** | | **Grade 9** | |
|---|---|---|---|---|---|---|
| | **Girls** | **Boys** | **Girls** | **Boys** | **Girls** | **Boys** |
| Refrained | 1 | 0.9 | 1.1 | 0.3 | 2.5 | 2.4 |
| On holiday | 0.3 | 0.6 | 1.8 | 0.5 | 0.5 | 0.7 |
| Parent denied participation | 0.3 | 1.2 | 0 | 0.3 | 0 | 0 |
| Incidental disease | 3.3 | 2 | 3.1 | 3.9 | 4 | 5.9 |
| Chronic sickness | 0 | 0.3 | 0 | 0 | 0 | 0 |
| Unknown reason | 6.3 | 2.3 | 3.6 | 1.8 | 10.9 | 10.3 |
| **Participated** | **88.7** | **92.7** | **90.5** | **93.2** | **82.1** | **80.7** |
| Total | 100 | 100 | 100 | 100 | 100 | 100 |

The number of participating students represented less than one percent of all Swedish students in these grades respectively (0.5 % in grade 3, 0.6 % in grade 6 and 0.6 % in grade 9) (National Agency for Education 2001, personal communication).

In addition there was a 3 % (n=67) drop out rate for the health questionnaire (Study I, II), primarily caused by technical reasons and a few no appearances and incidental disease.

The number of students in the different studies was as follows (in chronological order of test date):

**The SSH-project 2001.** "The base study" from which papers I and II are based on, registered 1,908 students (from grade 3: 255 girls and 305 boys, grade 6: 347 girls and 352 boys, grade 9: 329 girls and 320 boys).

**The SSH project 2002.** This study (paper IV) was carried out a year and a half after the base study during four weeks in October 2002, with a sub sample of the original 6th grade classes from eleven different schools. The schools were selected according to results from the base study, where they were ranked as being the most or the least physical active schools of all the participating schools. Level of physical activity was for the purpose of this study considered unimportant since it was a methodological study with the aim of comparing answers from students and their parents. The students had at the time of the study entered 8th grade and were age 14 at the onset of the year. Only those students present at school on the test days were included in this investigation. Their parents were invited to participate in the study through answering similar questions as the students.

In total 232 students (45 % girls and 55 % boys) completed the questionnaire and 200 parental responses were collected. The majority of the parental questionnaires were completed by the mother/stepmother (86 %) and thereafter by the father/stepfather (13 %). Another female adult family member (0.5 %) completed one questionnaire and there was one missing answer (0.5 %). One hundred and eighty-six (186) corresponding student-same parent questionnaires were registered which gives a corresponding same child same parent response rate of 82 %.

**The SSH-project 2004,** from which paper III is based on, was carried out three years after the base study, in the spring of 2004. All students in the base study were once again contacted and asked to participate by answering a similar questionnaire as three years earlier. At the time of the follow-up study, the students were 12, 15 and 18 at the onset of the year, and attended grade 6, 9 and 12, or had left school.

After the initial mail contact, the response rate from the students in 2004 was 44 %. A reminder was sent to the non-responders after a month, which provided an additional 7 %. A second reminder was sent out three weeks later, this time including a new questionnaire and a prepaid return-envelope. No reply-increasing rewards were offered to the responders at any time. Within

two months of the first contact 67 % of the students, who completed the questionnaire in 2001 had responded giving a total of 1,276 responders (from grade 3: 191 girls and 220 boys, grade 6: 263 girls and 239 boys, grade 9: 197 girls and 166 boys). The range of response over grade and gender was 50 %-75 % (Table 1).

Twenty eight percent of the students were either unable to be contacted or chose not to return the questionnaire. Another five percent of the students returned a note stating that they no longer wanted to be part of the study. Some students (10-30 %), depending on geographical location of home, had moved since the base study. Students in 12$^{th}$ grade (18 years) especially, from rural areas had left their home village for high schools or work in nearby cities. Though a postal company updated our address list, letters were returned with unknown address. Students from the base study were also recorded as having a private address and we did not want to intrude on their privacy by contacting them at their home address. The response rate from students at different schools ranged from 35 % to 93 %, with the former being from a school enrolling many students with non-Swedish ethnic background.

Since information of the non-responders is plentiful, we have been able to compare their characteristics with those that responded. Dropout analyses showed that there were no statistically significant differences in ratings of the variables surveyed e.g. perceived pain, health, and physical activity level, between the group that answered in the base study from the group that chose not to answer or from the non-repliers, with two exceptions. The non-repliers in 2004 reported more abdominal pain in 2001 ($p=0.011$). Those that actively said they did not want to answer the questionnaire in 2004 reported more tiredness in 2001 ($p=0.009$). Hence, results from the students in 2004 can be compared with those from 2001, even with the low response rate obtained from students, and particularly from boys in grade 12 (grade 9 in 2001).
Throughout the studies, the students are referred to by either grade level or age at the onset of the year.

*"Alla är barn och de tillhör det gåtfulla folket" Olle Adolphsson*

# METHODS

In the base study (Studies I and II) the students traveled by bus, plane or train to the three, designated test centers in Stockholm, Malmö and Gothenburg. Their expenses for the trip and if necessary, the overnight stay were paid for by the study budget. Classroom teachers, assistants and a number of parents accompanied each school class during their test day and stay.
On the test days (for Study I and II) the students and the accompanying persons arrived at The Swedish School of Sport and Health Sciences (GIH) in Stockholm, where the majority of the tests took place. Some students from the southern and south-western part of Sweden were tested at similar test centers in Malmö and Gothenburg.

For Study IV, the research team traveled to the selected schools throughout Sweden, and met once more, in person with all students. The parental answers of this study were collected from the mailed out questionnaire that were sent out at the time of the visit with their children.

For Study III, with data from the follow-up study, all students were contacted by mail.

**Testing procedures (base study 2001)**
Each class of students was divided by gender while being tested. Half the group answered a life-style questionnaire, with questions addressing physical activity, demographic characteristics, and socio-economic background. Thereafter they were tested for functional, gross-motor skills i.e. complex movement patterns with a focus on room orientation, dynamical balance, supporting strength and other coordinative body movements. The other half of the group recorded anthropometric data and performed physiological tests of physical performance, fitness, and strength which are part of "Euro Fit" tests along with a sub maximal bicycle test of oxygen uptake (Ekblom et al., 2004, 2005). Furthermore, the students´ bone density (heal site) was measured with DEXA (unpublished data), and they were examined for general joint laxity, shoulder joint laxity and mobility (Jansson et al., 2004; Jansson, 2005) and malalignment of the lower extremities (unpublished data). All of the tests, referred to above, were investigated by others in the SSH research group, and are beyond the scope of this thesis to cover.

At this time, as part of the medical tests, the students answered a health questionnaire, which was the main investigative tool in this thesis (see below). The physiology and medical tests took place in a large gymnasium, where screens were set up between the different stations to secure peace

and privacy. Depending on the size of the class the two groups switched after approximately an hour and a half. The entire testing session for the entire class lasted approximately half a day, including a break for a snack. The students were also provided a free lunch at the test centers.

**The health questionnaire**

The health questionnaire was constructed for the purpose of the studies and in collaboration with a paediatrician and two orthopaedic surgeons trained in sports medicine together with the project group. Prior to the first study, the questionnaire was pre-tested by children of the corresponding age groups. The wording, comprehensibility, and relevance of the questions were discussed with the students. The length of the questionnaire and time of completion was also considered. Thereafter, in November 2000, a pilot test was performed with 103 students from grade 3, 6 and 9. At this time all the various parts of the entire SSH project were tested.

The health questionnaire in 2001 consisted of five parts addressing the students' (I) medical background, (II) perceived health, (III) injuries, (IV) eating habits, (V) alcohol, tobacco and drug usage. This last section (part V) was not included for the 3rd grade children, but the questionnaire had otherwise the same tenor for the different grades. This latter part (V) was omitted in the follow-up study (Study III) since two questionnaires were combined for practical reasons, and it was necessary to limit the research focus.

In all studies with the exception of the follow-up, the students were, upon request, assisted by the principle investigator (GBS) and/or accompanying teachers, in their interpretation and reading of the questions. If an injury had occurred during the assigned recall period, we discussed the incidence, and checked that it was within timeframe and definition. Also questions concerning medical diseases and handicaps were sometimes discussed and confirmed with their teacher. However, those assisting were instructed to show discretion and not overlook the students answering the parts concerning perceived health, alcohol, tobacco, and drug-use. At all stages of the tests the students´ anonymity and confidentiality of answers was emphasized.

The same recall time, from "the onset of the spring term" i.e. early January until the testing dates in March/April, a recall period of 10-14 weeks, was chosen for studies I, II and III. This period was selected for practical reasons, i.e. easy cut-off dates for the students as well as for facilitating the possibility of scientific comparisons with other studies. The child-parent agreement study (IV) took place in October, so the onset of their recall was a similar time but in the fall term.

Questions concerning physical activity, demographic characteristics, and socio-economic information were covered in a lifestyle questionnaire, constructed by the head project leader of the entire research project, Professor Lars Magnus Engström in collaboration with colleagues from the research group. As described above the students answered the life style questionnaire in a separate session from the health questionnaire but in the same manner including personal assistance if required. The lifestyle questionnaire was also pre as well as pilot tested beforehand (Engström, 2004a,b).

The original Swedish health questionnaire, along with a directly translated version, can be found in the Appendix.

**Study I:** The focus of Study I was injuries during physical activities. An injury was defined as a traumatic incident, resulting in medical attention/care by a school nurse, doctor, or at a hospital. On the test day, the definition was further extended and explained verbally to the students, as an incident during physical activity at school or during their leisure time, that made them interrupt their activity and seek medical attention by an adult, such as a physical education teacher, trainer, parent, school nurse, doctor, and/or dentist.

**Study II:** As a measurement of their perceived pain and health, the students were asked in the health questionnaire to recall frequency of headaches, abdominal, and musculoskeletal pains, not caused by an injury or known medical disorder or disease, since "the onset of the spring term" i.e. the same recall period as described above. The frequency of recalled pain was graded on a 5-point Likert scale, which consisted of the answers; (1) never or almost never, (2) now and then (3) often (every week) (4) very often (5) always. On an outlined drawing of a human they could mark the exact location of their pain and in a subsequent question describe the time scale of symptoms. The same Likert scale was used for assessing problems sleeping and/or if they often felt tired, lonely, or sad.

**Study III:** For this study there is a methodological difference in that instead of researchers personally meeting the students, the questionnaire was sent out to them by mail.
The questionnaire in 2004 was a combination of the health questionnaire used in this thesis and the lifestyle questionnaire previously described. The wording of the questions was identical to the questionnaire answered by the same students in the base study (2001), but some questions were

omitted and some new included. A new question was included which addressed in what situations the students experienced musculoskeletal pain. They were further asked to rate prevalence of stress on the same Likert scale used for the other pain and perceived health parameters.

Through a wide range of questions in a life style questionnaire (Engström, 2004a,b), the students were asked about the frequency, intensity, and regularity of their physical activities. These activities included 1) walking or bicycling back and forth to school, 2) walking or bicycling back and forth to activities and/or friends after school, 3) participating in physical education class, 4) physical and sports activities with a coach in a sports club (outside school), 5) physical and sports activities after school without a coach or in a club setting. Points were given based on type of activity as well as frequency, intensity and regularity thereof. The accumulated points were added and a physical activity-index (PA) was constructed based on the reported information. Furthermore, the students´ own perceptions of their personality, as to their being physically active or not, were included as a factor in the index (Engström, 2004a,b). The students were classified into five levels of the activity index and the distribution of students in 2001 and 2004, the latter shown within parenthesis, was for level 1 (most inactive): 9 % (9 %), level 2: 15 % (17 %), level 3: 47 % (44 %), level 4: 18 % (18 %) and level 5 (most active): 12 % (13 %). For logistic regression analyses, when level of physical activity was tested as a possible explanatory factor (Study III) this 5 level index was dichotomized by regarding level 4 and 5 as ”physically active”.

**Study IV:** The child-parent agreement study used a questionnaire that was with minor revision, identical to the questionnaire answered by the same students in the base study (2001). Questions addressed their a) medical background, i.e. handicaps, chronic or prolonged diseases, and if any recent surgeries or fractures, requiring a cast, had occurred since the onset of the fall term; b) injuries and accidents during the recall period and since the base study, respectively, including information of site of, type of injury and setting; and c) perceived health. Again, all students reporting an injury orally clarified their injury with the principle investigator (GBS) so it complied with the definition and recall period (cf. above p 28). As a measure of the students´ subjective well-being they were asked to recall their perceived health “since the onset of the fall term”, i.e. mid August until the testing date, in October. Thus, the recall period was 7-11 weeks, a similar time period as in all studies but with the exception of recalling a different season of the year. This is however, of minor importance since the data has not been used for comparisons with studies I-III.

**Questioning questionnaires**

No fail safe ways have been described on how to develop a questionnaire or to verify if a measurement truly corresponds with the values of an attribute. Therefore, some errors probably are inevitable. When assessing health related parameters, even for young children, the self-report is considered to be the gold standard (Goodman et al., 1991; Perquin et al., 2003). In studies by McGrath et al. (2000) and Haugland et al. (2001b) children and adolescents were found to have a good recollection and were able to accurately understand, evaluate, and report their pain and complaints. Satisfying test-retest reliability (ICC or kappa value) on symptom checklists for adolescents was also established by Haugland et al. (2001b). Even children as young as age 4-5 years have proven to reliably report pain severity on various scales (Manne et al., 1992; McGrath et al., 2000; Committee on Psychosocial Aspects of Child and Family Health, 2001; McClain. 2002; Singer et al., 2002).

When designing a questionnaire for children and adolescents, attention must be given to the wording of the questions, that it is comprehensive, and contains suitable answering alternatives. Regardless of age of the responders, the selected answers and the scoring systems used should be designed so that they can easily be converted into coherent data and correctly processed and analysed statistically (Rust et al., 2000). Moreover, the reliability and validity of the instrument is of ultimate importance in research, and is considered a cornerstone when designing a questionnaire (Morrow et al., 2000).

**Reliability**

Reliability is associated with the accuracy, consistency as well as the repeatability of a test e.g. questionnaire (Morrow et al., 2000, Rust et al., 2000; Trost, 2001). A reliability coefficient differentiates between the ratios of measured variance that is a true score from a random error. To test for reliability the same subjects must answer the questionnaire at least twice within no longer time than four weeks (Morrow et al. 2000).

According to Morrow et al. (2000) ANOVA and the Pearson product-moment (PPM) correlation coefficient can be used for testing both reliability and validity. The reliability coefficient may be divided into inter and intra-class coefficients. The interclass reliability of a questionnaire can be tested through a test-retest procedure, mentioned above. When using intra-class reliability with ANOVA two or more trials can be tested for reliability. Beside ANOVA, models tests such as

Cronbach alpha coefficient (testing affective domains) or Kudar-Richardson formula 20 can be used (Morrow et al., 2000). The choice of method depends on the specific research question as well as whether the data is continuous (ratio scale or interval scale) or categorical (nominal or ordinal) (Pallant, 2001). In spite of statistical tests, a low test-retest score may reflect actual changes in feelings or opinions, and on the other hand, a high score can be due to recollection of answers earlier given.

**Test-retest study**

The present health questionnaire was tested for reliability in a one-week test-retest procedure with 38 schoolchildren in March, 2002. The comparison of their answers on questions rated on an ordinal scale was made using the statistical procedure of Spearman Correlation and Intra-class coefficient (ICC Alpha). The strength of agreement was good to very good (Landis et al., 1977; Cohen 1988 cited in Pallant, 2001) with values above 0.8 (ICC: 0.9) for pain variables and above 0.9 (ICC: 0.9) for sleeping problems and tiredness. Feeling lonely and sad received a Spearman value of 0.7 (ICC: 0.8).

For questions focusing on sports related injuries 8 out of the 38 students in this test-retest study reported that an injury had occurred during the recall period. One student failed to complete the questionnaire at the second occasion. The other seven students gave an identical answer on 99 % of the 54 questions/ items given. The reliability coefficient value, using Kappa, was not used in this section of the questionnaire due to the low number of subjects.

**Validity**

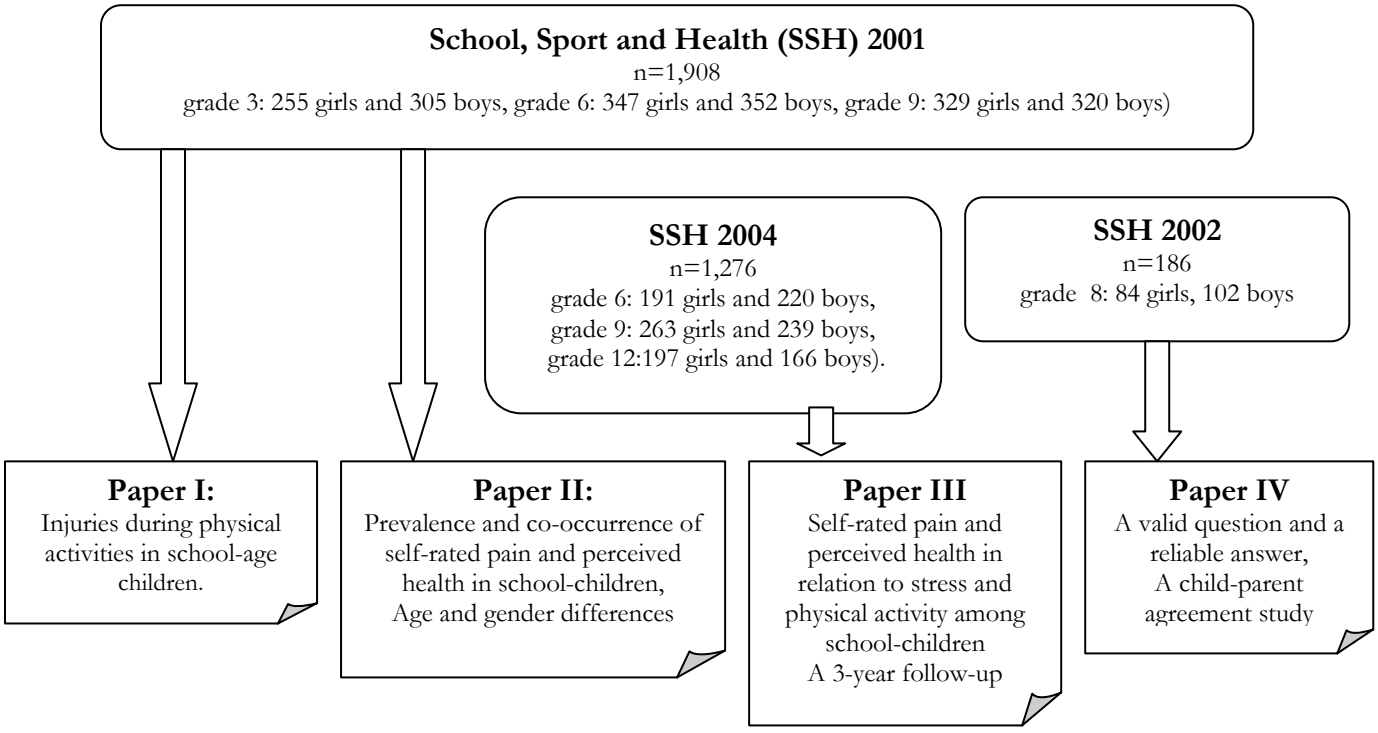
A test cannot be valid if it is not reliable and relevant. If the reliability is high the validity can nevertheless be low, if we do not measure what we intend to. The internal validity of the research is dependent on the accuracy of the measuring techniques applied. The aim of validity is to confirm the relevance of the instrument for its purpose. "Content validity" means that the content of the questions being asked measures what it intends to do, what we would like to know (Morrow et al., 2000). "Face Validity", addresses whether the questionnaire is suited and designed for the right target group. The health questionnaire was first pre-tested for relevance and comprehension by school students of the corresponding age groups, and thereafter in a pilot study with over one hundred students. "Construct validation" is the one unifying and overarching framework for conceptualizing validity evaluations (Shepard, 1993). The conception combines logical (content) and statistical validity and is important in attitude measurements,

things that are unobservable (Morrow et al., 2000; Rust et al., 2000). Construct validation was, for the health questionnaire, performed by comparing related questions (i.e. students´ answers on periodic and regular intake of medication with their reports of asthma, allergies and illnesses) with satisfactory results.

Steps to secure validity of a questionnaire includes initial review from and cooperation with experts in the field, pilot testing with subjects, resembling the target group, and assuring the respondents anonymity and confidentiality (Morrow et al., 2000). The present questionnaire was constructed in collaboration with a paediatrician and two orthopaedic surgeons trained in sports medicine. Regardless of the procedural steps taken the validity of a test must be re-established in every new specific setting, like "a never-ending process" (Shepard, 1993).

Prevalence of pain and perceived health in 2004 were similar at grade level and for gender when compared to reports in 2001, which indicates that the health questionnaire can be regarded as being a stable instrument, at least over the three year time period tested.

**An overview of the studies included in this thesis:**



## STATISTICAL METHODS

The studies were cross sectional surveys, which by their design aspire to capture, as in a snapshot, the perceived health and self reported injuries of 1,908 students from all over Sweden. Throughout the studies, results and statistical analysis have been separated for age/grade level and gender.

For data processing and statistical analyses of the questionnaires SPSS (Statistical Package for the Social Sciences) for Windows, at first version 11.0 and later version 14.0 (Chicago, IL, USA) and SAS® System 9.1, (SAS Institute Inc., Cary, NC, USA) were used.

The initial electronic scanning of the questionnaire data and logging into a SPSS sheet was made by a computer company. Before analysing the data, a selection of the questionnaires were checked by the principle investigator (GBS) thus ensuring that they had been properly completed and transferred into the database. This spot test of the scanning work revealed an unacceptable rate of error which led to a new check. Consequently, every single questionnaire was manually read and checked for accuracy in transition from questionnaire to database. This was of importance not only for technical problems of transferring, but also because students had misplaced marks (outside the box) and when incorrectly ticketing the right box, vaguely erased their errors. In addition, sometimes there was extra written information covering other boxes, which subsequently interfered with the computer scanning. Even folding a questionnaire was registered by the sensitive scanners. In future studies, since this was an extremely time consuming procedure, it may be recommended that, if economy allows, the questionnaire can be uploaded on the Internet, allowing quick and easy assess for the students and correct transferring to datasheets.

In all studies, frequency of data was first analysed with descriptive statistics and cross tabulations. Chi-square was used for examining group differences with the following level of statistical significance *$p<0.05$, **$p<0.01$, ***$p<0.001$. Values $>0.05$ were considered as statistically non significant (n.s.).

The specific statistical tests used in the different studies were as follow:

**Study I:** Answers of the sports injury part of the questionnaire were assigned binary scores (yes = 1, no = 0), or open type. Descriptive statistics, with categorical data presented as "percent frequency of occurrence" was used to summarize the results.
The Chi-square test was used for examining group differences with statistical significance level set at $p<0.05$.

**Study II:** Data were at first examined by both frequencies and cross-tabulations.
Analyses of age and gender differences in ratings of the ordinal variables (pain and perceived health was rated on an ordinal 5 point Likert scale) were performed using the non-parametric statistical procedures of the Chi-square test and the Mann Whitney U test.
The co-occurrence among the different pain and health parameters was also analyzed with non parametric tests (the Chi-square and the Spearman rank correlation coefficient). A correlation coefficient between 0.3-0.49 was considered moderate and 0.5 or more, large (Cohen, 1988 cited in Pallant, 2001).
For all analyses, the level of statistical significance in this study was set at $p<0.01$.

**Study III:** At first descriptive statistics and bivariate correlations were performed.
The Sign test was used when analysing individual changes in rating of pain and perceived health on an ordinal scale, from the base study in 2001 to the follow up date in 2004.

For analyses of the repeat cross sectional data, comparing grade 6 in 2001 with grade 6 in 2004 (i.e. former grade 3 in 2001) and comparing grade 9 in 2001 with grade 9 in 2004 (i.e. former grade 6 in 2001), ratings on the ordinal scale were tested by means of the Chi square test and the Mann Whitney U test, for independent samples.

Multivariate analysis of relationships was performed since we wanted to investigate the interactions of factors (gender, age/grade, level of physical activity, and stress). The procedure used was stepwise logistic regression analyses with significant independent variables entered consecutively with the variable having the lowest p-level for entry. Each of the pain and perceived health variables were used as a dependent variable. Level of physical activity was also included as an independent variable as was perceived stress. Each variable was, before being entered in the model dichotomized in such manner so ratings of 1 (never or almost never), and 2

(now and then) from the Likert scale were computed to one group of "no pain/complaints" and 3 (often (every week)), 4 (very often) and 5 (always) on the scale were regarded as a group "with pain/complaints", since according to the rating they occurred every week to daily. Age and gender was controlled for in the model. Results are presented as odds ratios with 95 % confidence intervals (CI). Each model predicts the probability of pain and complaints. The max-rescaled R-square ($R^2$) is presented as a measure of the goodness-of-fit for the logistic regression model (Nagelkerke, 1991).

Whether the various pain and perceived health variables were influenced by the interactions among the significant explanatory factors were also tested. Statistically significant interaction terms were included in the logistic model together with the main factors. When an interaction term was significant, several different odds ratios were calculated. For example if gender*stress was significant in a model predicting pain, we estimated the ratio of the odds of pain among boys reporting stress relative to the odds of pain among boys reporting no stress. The same procedure was then performed among the girls. The same procedure can be applied with the subgroup "stressed" comparing boys and girls.

In order to analyse the changes in rating of pain and perceived health from 2001 to 2004 in presence of age/grade and gender, we fitted a generalized estimating equations (GEE) model with the GENMOD procedure in SAS®. The GEE strategy is a useful approach for repeated measurements analysis of binomial outcomes in a longitudinal study. The model was set up with the within factor Year (2001, 2004) and the between factors Grade (3, 6, 9) and Gender (F, M). The interactions among the factors were also included in the GEE model. In case of significant interactions with factor Year, simple effects were examined, i.e. effects of factor Year were calculated for all the levels of the other factor. The estimates from the model and from the simple effects tests were odds ratios and 95 % confidence intervals.
The statistical significance level was set at $p<0.05$.

**Study IV:** The strength of agreement between responses from the student and his/her matching parent was studied by means of absolute agreement, which is the shared positive and negative answers from both students and parents divided by total number of responses presented in percent. Agreement was also analyzed with the Kappa coefficient, which corrects for chance and takes into account both the observed and expected value on the diagonal of a cross tabulation. For ordinal variables weighted Kappa was calculated, which includes weights given to values

according to their distance from the diagonal so to account for the magnitude of disagreement (Altman, 1991).

Descriptive statistics, with frequencies of answers was used in those cases where the students´ and parents´ questions did not share the same answering alternatives.

For all analyses, the statistical significance was set at $p<0.05$.

*"A cause is an Insufficient but Necessary part of an Unnecessary but Sufficient condition of the effect"*
*(John Mackie, 1974 cited in L-G Johansson, 1999)*

## ETHICAL APPROVAL

Prior to all investigations, students and their parents or legal guardians received a letter describing the study, together with information about the voluntary and anonymous nature of participation. Their written informed consent was obtained before each study commenced. In 2004, this letter of consent was accompanied by the questionnaire. The identity of the students was at all stages coded to ensure anonymity and their answers handled with confidentiality.

All studies in this thesis were approved by the Ethical committee at the Karolinska Institutet, Stockholm, Sweden (Ref. no. 00-416; 2001-03-05 and complementary 2002-07-01).

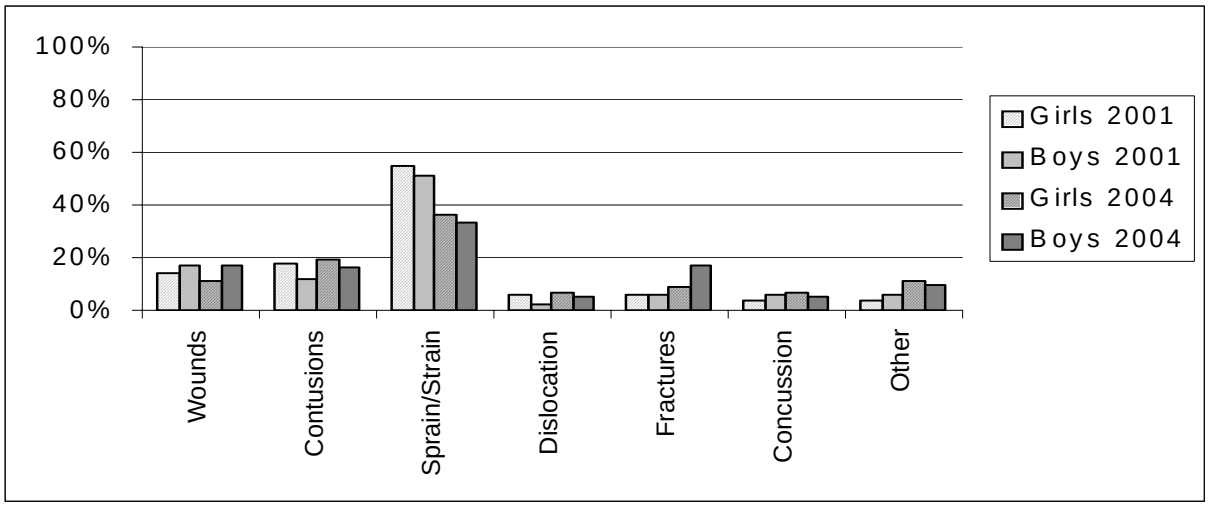
# RESULTS

## Study I

Study I, with data from the base study, was a descriptive epidemiological survey, which provided information concerning self-reported injuries sustained during various physical activities, as it had been recalled retrospectively for three months (10-14 weeks) by the students.

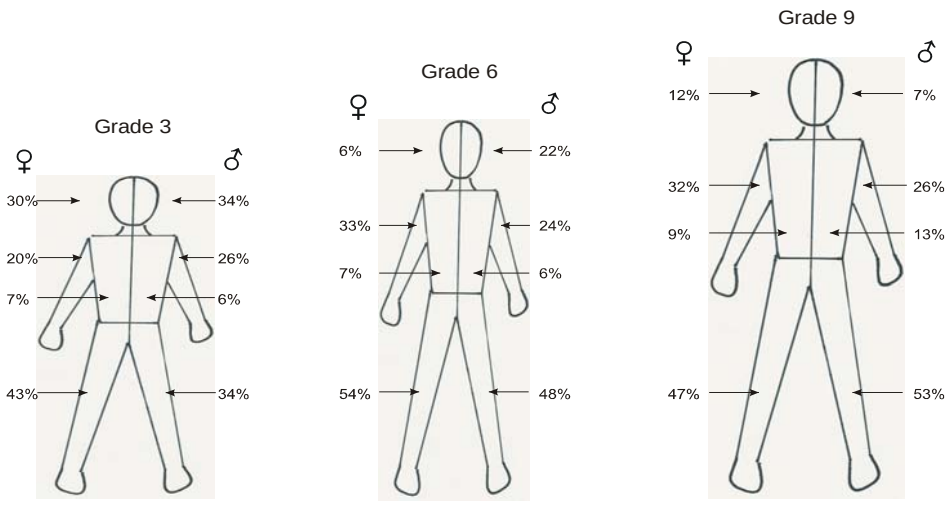
Every sixth student (17 % of the girls and 15 % of the boys) reported an injury during the recall period. The most common type of injury was a strain and/or a sprain, sustained through a fall or a twisting movement (Fig 3).

**Figure 3** Type of injury



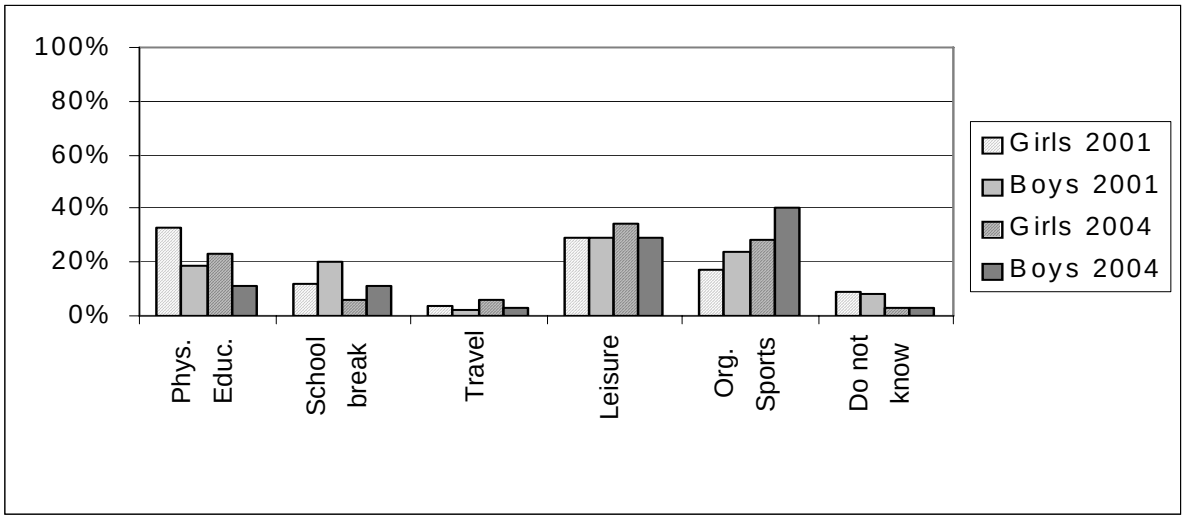

The lower extremity was the most frequently injured body site (47 %), followed by the upper extremities (27 %) (Fig 4).

**Figure 4** Location of injury



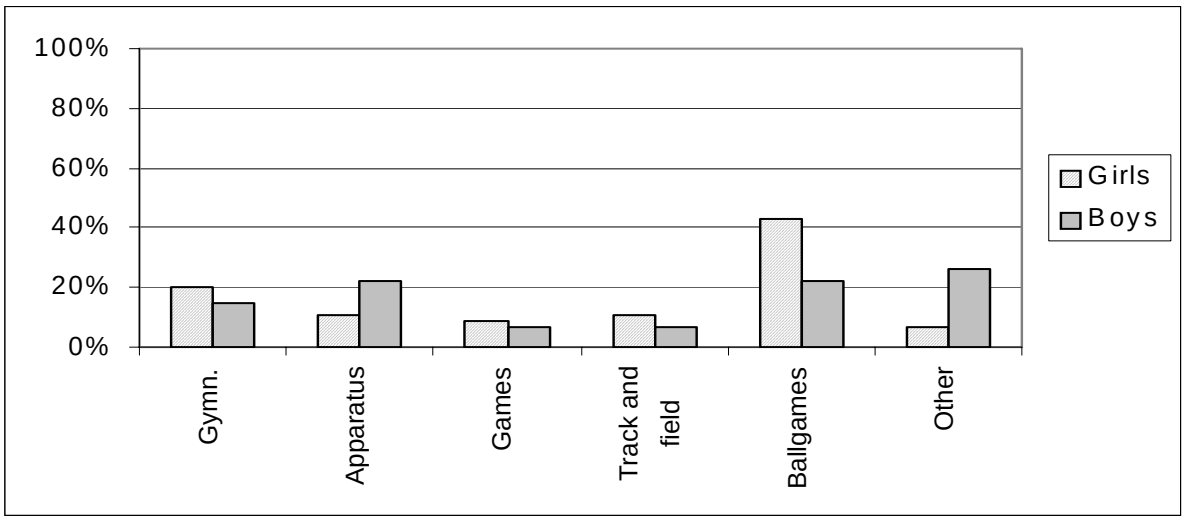
Most injuries occurred during unorganized physical activities at leisure time (29 % of the injured population), especially for the third grade children (p=0.007, compared to the other two grades). The second most common setting for an injury was physical education class (PE) (25 %) (Fig 5).

**Figure 5** Injury setting.




During PE, girls sustained twice as many injuries than boys (p=0.004), and they reported that they were most often injured while playing ball games (45 % of their cases) (Fig 6).

**Figure 6** Activity when injured during physical education class.



Students with an impaired vision reported twice as often that they had been injured during PE class ($p=0.009$). Ninth grade students reported relatively more injuries during organized sports but there were no age or gender differences in prevalence rate during leisure activities.

Parent(s) or another adult member of the family was generally the first to care for the injury at the time of occurrence (33 %). The physical education teacher, class, and/or athletic trainer initially cared for 26 % of the incidents in all age groups.

Most injuries were minor, as 70 % were back in physical activity within a week. However, every other student (50 %) reported that they previously had injured the same body part.

**Three years later (unpublished results)**

The same students (see Subjects Study III p. 25) were in the follow-up study in 2004, asked to recall if, since the base study (2001), they had sustained an injury that was so severe that they had sought medical care at a hospital. One fourth of the girls (25 %) and nearly one third of the boys (32 %) reported that they had sustained an injury that needed medical care from a hospital since three years earlier. The number of reported injuries during the 3-month recall period, which was the same as in 2001, was 391 (31 %). Compared to the base study prevalence for boys (35 %) surpassed that from girls (26 %). One fifth (20 %) of the students who reported a 3-month recall of an injury in 2001 did so again in 2004. Moreover, of those injured in 2004, 59 % of the girls and 66 % of the boys were the same students that also had sustained an injury so severe that they had had to seek medical care at a hospital between 2001 and 2004.

Sprains and strains remained the most frequently reported types of injury, but prevalence of fractures increased for boys. In 2001, 6 % of the injured boys reported a fracture compared to 22 % of the injured boys in 2004.

As previously mentioned, in 2001 most injuries were minor, since 70 % were back being physically active within a week. Injuries in 2004 were apparently more often severe in that less than half could return to physical activities at school (49 %) or to their organized sport activity (38 %) within a week. Another 44 % (39 % for organized sport) returned within a month. Eight percent were injured at the time of the survey. The remaining percentages of injured students were not active within organized sports. More students 65 % had sought medical care from a doctor or physical therapist at the time of the injury compared to the base study, when 17 % had

sought such care. Four percent of the injured students in 2004 and 3 % in 2001 said that their injury and sometimes multiple injuries had made them stop with sport activities during leisure time.

In the base study there was no significant difference between activity levels among the injured students. In 2004 the most active students were also those that reported more injuries (53 % of the very active boys and 36 % of the very active girls (PA index 5 see Methods) compared to 14 % of the inactive boys and 6 % of the inactive girls (PA index 1).

Of those injured during the spring in 2004, while active in organized sport training or competition, most (>60 %) said that they practiced their sport 2-4 times a week, most often 1-2 hours at time, and over 80 % had been active with their sport for over 2 years. Being new to a task (in a sport) has often been referred to as a risk factor and 7 % of those reporting an injury during organized sport activities had participated in it for no longer than the start of the semester.

Another often quoted risk factor is ill-fitted or absence of protective equipment. Twenty-five percent of the girls and 17 % of the boys reported in 2004 that they had not been using the protective equipment recommended to their sport at the time of injury.

Most self-reported injuries during organized sports occurred while playing soccer. However, it should be noted that in comparison to any other sport, this is the activity that engages most school-age children in Sweden. In the base study, one fourth of the students were members of a soccer club and an active player. When dividing number of injury incidents while playing soccer with number of active players/members, 4 % of the soccer active students (22 injured/496 active members) had sustained an injury during the recall period. Noteworthy is that the recall time is not a peak season for soccer. January to March may be the peak season for ice-hockey in Sweden and in the base study 9% of the hockey players reported an injury (9 injured/116 active members). In 2004 the number of injured active players had increased to 32 %, for the same time period. Following soccer and ice hockey, the third setting where most injuries occurred was basketball in 2001 and floor ball in 2004 for boys. Girls were most often injured while playing soccer, basketball (2001), riding horses and thereafter while playing handball (2004).

In the follow up study (2004) 5 % of the 12 year old students, 17 % of the 15 year old students, and 18 % of the 18 year old students had quit being an active member in a sports club/ team.

Having joined as a new active member was reported by 27 %, 7 %, and 7 % from the respective age groups resulting in 46 %, 56 % and 42 % being active in clubs and teams in 2004. Remaining students 22 %, 17 %, 32 % were non-members both years.

**Study II**

Every other student (50 %) reported that they had experienced pain, either as headache, abdominal pain or musculoskeletal pain, within the 3-month recall period.
Twice as many girls (17 %) than boys (8 %) reported that they suffered from headaches at least once a week to daily. This gender difference was noticeable at all grade levels ($p<0.001$). Students who reported vision impairment reported more often frequent headaches, 18 % compared to 11 % of the students with correct vision ($p<0.001$). The prevalence of headaches varied in the participating schools ($p<0.001$).

Twice as many girls (10 %) than boys (5 %) reported abdominal pain by the same frequency. For boys, abdominal pain was most common among the third grade students (7 %) ($p<0.001$). Complaints of musculoskeletal pain increased with age for girls from 6 % in grade 3 and 5 % in grade 6 to 12 % in grade 9 ($p<0.01$). For boys, complaints remained between 9-10 % from grade 3 to 9. Single site of pain was reported by 63 % of the students, pain at two sites by 26 % and three or more sites by 11 %. More than half (52 %) of the students with frequent pain reported that it had been persistent for over a month.

Twelve percent of the students reported that they often had problems sleeping. Most problems were expressed by boys in grade 3 (16 %) followed by girls in grade 9 (15 %). Prevalence of tiredness increased with age, and gender differences in tiredness were found between students in grade 6 and 9 ($p<0.001$). Feeling sad and lonely by the defined frequency was expressed by 5 % of all students for both variables respectively.

Eight to 15 % of the students (depending on gender and grade level) reported frequent (at least once a week to daily) complaints on two of the rated variables. For the total of the seven variables, the perception of pain and health complaints decreased with age for boys from grade 3 to 9 ($p<0.01$), while the complaints increased for girls ($p<0.001$).

Every third girl (32-38 % grade 3-9) and every other boy (50-55 %) answered that they never or almost never suffered from headaches or abdominal pains. Sixty-three percent of the students

answered that they had not experienced any musculoskeletal pains during the recall period. More than half (56 % of the girls and 59 % of the boys) had never or hardly ever had problems sleeping. Absence of tiredness was reported by 28 % of the girls and 37 % of the boys. Three fourths (73-76 %) of the boys said that they never felt sad or lonely. For girls though, while 72 % also said they never felt lonely, only 52 % said they never felt sad.

Co-occurrence among the variables was moderate (0.3-0.5) (Pallant, 2001). Above all, feeling lonely and sad was associated with each other across grades and gender. Students with frequent headaches were also significantly more likely to report other sites of pain and health related complaints.

**Study III**

The responses given by the same students in 2001 and 2004 showed a continuing increase for girls of frequent (daily to at least once a week) complaints over the three year period. In contrast boys reported a decrease with the exception of tiredness, which increased with age for both genders. More girls (12 %) than boys (4 %) reported frequent pain at both measurement periods. Over half (56 %) of the girls and two-thirds (67 %) of the boys reported no frequent complaints either period.

Stress, which was only assessed in 2004, was most prevalent for girls in grade 12 (61 %), whereas 30 % of the boys at same age reported feeling stressed every week to daily. Least stress (4 %) was rated by boys age 12 (Table 3).

**Table 3** The distribution of perceived stress between grade (in 2004) and gender, n=1273*.

| **Stressed (n)** | **Grade 6** | | **Grade 9** | | **Grade 12** | |
|---|---|---|---|---|---|---|
| | Girls[ac] | Boys[ac] | Girls[b] | Boys[b] | Girls[bc] | Boys[bc] |
| Never/Almost never | 96 | 129 | 50 | 113 | 16 | 59 |
| | 50 % | 59 % | 19 % | 47 % | 8 % | 35 % |
| Now and then | 70 | 81 | 106 | 92 | 61 | 58 |
| | 37 % | 37 % | 41 % | 39 % | 31 % | 35 % |
| **Often (every week)** | **25** | **9** | **105** | **34** | **120** | **49** |
| **to always** | **13 %** | **4 %** | **40 %** | **14 %** | **61 %** | **30 %** |

* 3 students failed to answer the question. [a] ($p=0.017$) for gender differences in grade 6.

[b] ($p<0.001$) for gender differences in grade 9 and 12.[c] ($p<0.001$) for age difference grade 6-12

Prevalence of stress varied in the participating 48 schools and especially for girls (p=0.035 at grade 6 and p=0.049 at grade 9). In some schools no one felt stressed as per our frequency definition and in others 86 % of the girls (19 girls out of 22 in the class) reported stress.

When comparing change in assessment at grade level i.e. grade 6 in 2001 with grade 6 in 2004, most variables were rated the same as three years earlier.

The risk of complaints, as calculated with odds ratio, was most evident for students who were characterized as being physically inactive in 2001 and remained inactive three years later. The second most explanatory factor was gender (being female) on all variables but tiredness, where grade level (increasing age) was second to stress. Jointly, significant predictors, such as stress, being physically inactive, gender and grade level explained 8-20 % of the frequent complaints.

*Point prevalence of back pain (unpublished data)*

Prevalence of back pain was in this study grouped with musculoskeletal pains in addition to being independently reported at point prevalence i.e. a question phrased as: "Have you or have you had back pain today?" Exceeding all other groups, students from grade nine (24 % of the girls and 21 % of the boys) reported that they had experienced back pain during the test day in 2001. This number was twice to three times as high as for the younger students (p<0.001). Point prevalence of back pain, in the 3-year follow-up, increased significantly for girls (p<0.001) (Table 4).

**Table 4** The distribution of point prevalence of back pain between age and gender in 2001 and 2004.

| | **Grade 3 (in 2001)** | | **Grade 6 (in 2001)** | | **Grade 9 (in 2001)** | | **Total** | |
|---|---|---|---|---|---|---|---|---|
| | Girls | Boys | Girls | Boys | Girls | Boys | Girls | Boys |
| Back pain (2001) n=1908 | 7 % | 6 % | 10 % | 8 % | 24 % | 21 % | 14 % | 12 % |
| Back pain (2004) n=1276 | 15 % | 10 % | 30 % | 15 % | 41 % | 27 % | 29 % | 16 % |
| **Change** | **+8 %** | **+4 %** | **+20 %** | **+7 %** | **+17 %** | **+6 %** | **+15 %** | **+4 %** |

**Study IV**

Once a child is in good health, in absence of disease, pain and injury, the child-parent assessment matches up. Twice as many students listed handicaps or chronic diseases, defined as hindering physical activity, compared to their parents. When recalling and reporting injuries that had occurred since 2001, as well as during the recall period, only every other case to one third demonstrated exact child-parent agreement of the incident. However, children and parents showed agreement in cases of very severe injuries and daily complaints of knee pain.

Less frequent headaches, back and musculoskeletal pain and other complaints of less well-being, such as students' tiredness, were all under-reported and under-rated by their parents. Most parents (69 %) felt that the general health status of their child was "very good" and 31 % "good".

**Unpublished data**

The questionnaire used in the SSH-studies covered many topics, for example the students' medical background, dietary habits, tobacco, snuff, alcohol and drug usage. In the appendix a translated version of the questionnaire can be found for reference. The following presentation of the main findings has previously not been published.

The intention of this part of the questionnaire has not been to specifically record the prevalence of diseases among Swedish school children and students, but rather to describe whether diseases or handicaps were perceived as preventing them from being physical active at school or in their free time. Their health related behaviours, dietary habits and tobacco, snuff, alcohol or drug usage, were studied in relation to differences in students´ age, gender, and levels of physical activity.

*Medical background*

*Allergies and Asthma*

One out of four students (23 %) reported in 2001 that they had allergies and less than one out of ten (8 %) asthma. A high of 46% of the students in one class (n=28) reported allergies and a low of 6% (n=18) was reported in another class. The presence of allergy was associated with a higher frequency of headache ($p=0.014$), sadness ($p=0.016$), problems sleeping ($p=0.001$) and tiredness ($p<0.001$).

The majority of the students did not perceive that their allergies prevented them from participating in physical education class (81 % of the girls and 90 % of the boys). For students with asthma, over half (54 %) of the girls found it inhibiting at times, and 7 % found it to inhibit them all the time ($p=0.002$). Girls with allergies and asthma could not differentiate whether their symptoms had a greater affect while being physically active at school or in their free time. However, a higher percentage of boys found their condition to limit them more when physically active in their free time (w. allergy 15 % and w. asthma 31 %) compared to at school (w. allergy 10 % and w. asthma 26 %). Most students with asthma (84 %) reported that they took medications for their problems, compared to 54 % of the students with allergies.

*Diabetes, other chronicle or prolonged diseases or handicaps*

In our study nine students answered that they were diagnosed with diabetes, one girl and 8 boys. One of them stated that their disease was hindering at times in physical education class but none of them found a problem when physically active in their free time.

Five percent of the girls and 4 % of the boys reported that they had a handicap or a chronic disease. In this category the students listed diseases like epilepsy, rheumatism, cystic fibrous, CP, autism, chronic skin diseases (psoriasis), as well as chronic back and knee problems. Their conditions, taking into account the grouping of such varied symptoms, did not seem to make them less physically active than their healthy school friends, except for a tendency not to be a member of a sports club.

Students noting a handicap or chronic disease reported more often that they felt tired ($p<0.001$), had headaches ($p<0.001$), and pains ($p<0 .001$). They also listed more often that they felt sad ($p<0.001$) and had problems sleeping ($p<0.001$). Every third student in this group noted pain in the back during the test day, which made them more likely to note the matter, compared to the other students ($p<0.002$ for girls), ($p<0.012$ for boys).

*Previous surgeries and fractures*

Every fifth girl (21 %) and almost every third boy (31 %) recalled having had a surgery in their life time. The most common operations were in the ear, nose, and throat area. The higher prevalence of surgery for boys was accredited to surgeries of the testicles and scrotal hernia. The students were also asked in the survey whether they recalled having had a cast at one time or another. The reason for this question was to get a picture of how common it is for a child to experience a traumatic accident that leads to a fracture. Twenty percent of the boys and fourteen percent of the girls recalled having carried a cast for a fracture. Some of the students had multiple injuries on multiple occasions.

*Medication*

The students were asked to list any medication taken on a regular basis, i.e. every day, as well as any periodical intake of medications. Eight percent of the girls and six percent of the boys reported regular usage of medication. Slightly more girls (11 %) than boys (8 %) reported periodic intake of medicine. Medications were primarily taken for asthmatic problems, followed

by medicine for allergies and NSAID. For periodic usage almost half (48 %) was contributed to medications for allergies, followed by asthma and NSAIP.

Both regular and periodic intake of medications were statistically strongly associated with various pains, as headaches, abdominal pain and back pain ("today") ($p<0.001$-$p=0.003$) and also health variables as tiredness and sadness ($p<0.001$-$p=0.008$). These findings are inline with those documented by Hansen et al. (2003) examining adolescents´ self reported medicine use across 28 countries.

Students on regular medications reported that they drank alcohol more often than other students (11 % of students on medication vs. 3 % of total population, $p<0.001$). This finding was not manifested for those on periodic medications nor was there such a correlation with tobacco usage. No connection between regular intake of medication and level of physical activity was found. During the first three months of 2001 17 % of the girls and 13 % of the boys had been prescribed penicillin ($p<.006$).

*Dietary habits*

The students were asked to recall the regularity of their eating habits, i.e. breakfast, lunch, dinner as well as any in-between snacks. The answers were either (1) daily (2) often (4-6 days/week), (3) sometimes (1-3 days/week), or (4) never.

Most students reported that they started their day with breakfast (82 %) and the number increased to 93 % when looking at the youngest students in third grade. Among students in ninth grade more than one fourth (28 %) said that they started their school day without a meal. At all age groups, boys were found to eat breakfast ($p<.001$) and lunch ($p=0.001$) more regularly than girls. Of the most physical active students 87 % ate breakfast every morning compared to 75 % of the students in the least physical active group.

Eating lunch daily on a regular basis decreased from 92 % of the third grade students to 71 % of the sixth grade and 64 % in the ninth grade. Slightly more boys (78 %) than girls (72 %) ate lunch daily as did physically active (80 %) students compared to the inactive (71 %).

Three out of four students noted that they ate dinner at home every day and with no gender differences. Dinner was described as a cooked meal, which could include going to restaurants

and/ or eating home alone. These were two things which many of the students wanted us to clarify. A light snack such as a bowl of cereal or just a glass of milk and a sandwich was in this case not considered to be a cooked meal. The most physically active students ate dinner daily in 83 % of the cases, and of the physically most inactive, 68 %.

Every third student (32 %) noted that they ate a snack after school, gender alike, but with an increase by the third grade students to 41 %. One fourth (26 %) of the inactive students consumed a snack/an in between meal daily compared to 42 % of the most physically active.

Less than half (44 %) of the students stated that they ate fruit and vegetables daily. More girls reported daily intake ($p<.001$) and most fruit and vegetables were consumed by the nine year old girls in 2001 and the 18 year old girls in 2004. The least was consumed by boys, age 15 in 2004 with 22 % reporting daily intake of fruits and vegetables. When comparing the most physical active students, 55 % noted daily intake of fruit and vegetables compared to 33 % of the least active students.

One out of every tenth ninth grade student noted that they ate candy and chips daily compared to 5 % of the students in grade 3 and 6. Most students (71 %) said that they ate sweets sometimes and 3 % never.

*Tobacco, Snuff, Alcohol and Drug usage*

The usage of tobacco, snuff, alcohol, and drug products was only answered by students in grade 6 and 9 in 2001. The response alternatives on the question: Do you smoke/snuff? was a) never, b) have tested, c) now and then (one to a couple of times per month), d) regularly (every day). Alternative d) was for alcohol and drug described as every week instead of daily.

More girls (6 %) than boys (1 %) reported that they smoked every day. Among students in sixth grade 72 % stated that they never had tried smoking, 27 % had tested and of those in ninth grade slightly more than half (53 %) had still not tested smoking.

Five percent of the girls in grade 6 and 10 % of the girls in grade 9 had tested tobacco snuffing. Corresponding percentages for boys were 19 % in sixth grade and 17 % in ninth grade. Less than 1 % of the girls used snuff regularly compared to less than 5 % of the boys. Usage of snuff on a

regular basis was as common among the least (5.5 %) as well as the most (5.3 %) physical active students.

Almost two thirds (65 %) of the sixth grade students reported that they never had tested alcohol. Two percent used alcohol irregularly/now and then. Of the ninth grade students, one fourth (25 %) had not tested alcohol, 35 % said they drank it now and then and 5 % on a regular basis with no gender difference. When drinking alcohol, strong cider was most popular followed by strong liquor and beer with alcohol content above 3.5 %. Of those drinking alcohol, 13% said that they most often drank home-distilled liquor.

The physically active students in 2001 were less likely to adopt an unhealthy lifestyle with tobacco and alcohol usage at a very young age, 13 % of the most inactive students said that they smoked daily compared to none of the physically active. Six percent of the inactive students reported that they consumed alcohol at least once a week compared to 0.5 % of the active. Noteworthy is that these are reports from students as young as ages 12 and 15 years. Despite concern for intentional as well as unintentional underestimation of alcohol, tobacco and drug use, self-reported health related behaviour have shown to demonstrate validity (Vingilis et al 1998; Bremberg, 2006). Smoking but not alcohol usage has shown to co-variate with self-rated health and this is consistent with our findings (Vingilis et al 1998). Students, who reported that they smoked and drank alcohol on a regular basis were twice to over three times as likely to also report frequent headaches, pain, and feeling tired and sad.

Two percent of the students had tested drugs, of which hashish and marijuana was most common.

# DISCUSSION

The positive effects of physical activity are well recognized, but when physically active there is inevitably the risk of being injured. For the young students (Study I) most injuries were of minor severity (70 %) though with increasing age (three-year follow-up) students´ reports of type of injury and return to activity after the incident were longer, which indirectly is a sign of injuries of a moderate severity. Gender differences were established in injuries sustained during physical education, age difference during organized sports, but no age and gender difference during leisure activities.

The basis of injury prevention is to recognize both the causative and predisposing factors, especially those that can be influenced (Bahr et al., 2003). The ambition is to find athletes at high risk of an injury, with the intention to modify their behaviour. This is initiated by identifying and describing the problem in terms of incidence, severity, mechanism and other related factors, which was the aim of the first study in this thesis. In Study I, students' reports on these factors and other related questions beyond and complementary to other studies using e.g. medical records at hospitals and emergency units are important for increasing our knowledge of the mechanisms behind their injuries.

The aim of Study II and the follow-up Study III was to assess school students' perceived health, changes thereof and associated factors. Our longitudinal follow up with three years is a short period to detect any medical or health consequences of a sedentary lifestyle. However, our findings did show that the odds for reporting pain and perceived health complaints were significantly higher for students who were physically inactive in 2001 and whose reports in 2004 classified them again as being inactive. Most positive health was found among the physically active students. When calculating the risk in Odds Ratio (OR) if physically inactive among subjects participating in the base study, problems sleeping had an OR of 2.0 (95 % CI 1.1-3.5), for tiredness an OR of 3.6 (95 % CI 2.0-6.2), and for feeling lonely an OR of 4.3 (95 % CI 1.6-11.3) (Brun Sundblad et al., 2006). Furthermore, as was referred to in the previously unpublished data the physically active students in 2001 were also less likely to adopt an unhealthy lifestyle, reflected by tobacco and alcohol usage, at a very young age.

Regardless of activity level, actual prevalence as well as change in prevalence, of frequent complaints of pain and perceived health was related to gender and increasing age. For the three

year follow-up, girls' complaints continued to increase. In contrast, boys in our studies reported fewer problems with increasing age. Jointly, significant predictors, such as gender, stress, being physically inactive, and grade level explained 8-20 % of the frequent complaints (See Table 5 in Study III).

The aim of the fourth study in this thesis was to compare the agreement of answers from students with answers given by their parents regarding the students´ medical background and subjective rating of perceived health. In a sub sample of the students, their parents rated more positive health than the children themselves. The agreement was good in absence of pain and also if severe pain was frequent, but otherwise parents underestimated and underrated their child's pain and health complaints. Consequently, this suggests that, when assessing the perceived health and well-being of students, their own expressions should be the basis for the data collection and analysis rather than relying entirely on parental reports.

These four studies have tried to address some of the issues aimed for by the SSH research group. It remains for future research to combine data from the various studies within the project group as for example the influence of physical fitness and overweight on perceived health and gross motor skill on injuries etc.

**Strengths and limitations**

Sources of bias and limitations must be recognized and referred to. A general limitation and disadvantage of questionnaires is drop-out of both individuals and single answers and in those cases where the survey is mailed, the lack of guarantee as to who actually does answer. There is also the risk of memory biases and distortions by the responders, since sometimes incidents are forgotten, exaggerated, and/or diminished (van Mechelen, 1997; Crocker et al., 1998; Morrow et al., 2000). A measure to avoid this and enhance the quality of the questionnaire is when it can be combined with an interview, personal instructions, and one-to-one help. This may clear possible confusion, misinterpretation and eliminate social desirability and tendencies for indecisiveness or extreme responses in answers (Fox, 1998; Rust et al., 2000). Social desirability of the answers can also be controlled for through discussing "the phenomena" and assuring anonymity and confidentiality. A possible limitation, as earlier mentioned, is our own experience of both human errors and technical problems, when data is transferred from a questionnaire into a data sheet. This important issue was at least partly controlled and corrected for in the SSH studies by manually checking the database against the questionnaires.

Questioning a large number of students is a procedure to minimize bias, and it enables valuable sub group analyses (for example by age and gender), with information that otherwise would have been lost if regarded as one homogenous population. However, some argue that large sample sizes may possibly also create statistically significant results that however are clinically irrelevant. Therefore, it is important to also consider the factual results in percentages and not always focus on the p-value. Results from the base study were proportionally similar to those retrieved in 2002, with a sub sample of students and comparing same age, which lessen any concern that the size of population in the base study has boosted the significance.

Limitations brought on by the recall time period were discussed in each separate study. Our students recalled pain and perceived health during the months of January to March, which due to the cold and dark character of these months may affect some of the variables. However, Watson et al. (2002) showed in their study on English school children no difference in time of year and prevalence of reported low back pain. The prevalence of injuries, and especially type of activity at the time, are likely to have been influenced by the time period (winter-early spring season) in Study I, and any comparison with other studies should have the specific recall time in mind.

In epidemiological large scale studies questionnaire surveys may still be the only feasible alternative for estimating physical activity levels, despite arguments for the superiority of i.e. various activity monitors (Philippaerts et al., 2006). Self-reports of habitual physical activity, by older children and adolescents, was found to be valid and reliable in a study by Sallis et al., (2000b). With such a large sample size, the SSH studies' appraisal of physical activity level by means of a questionnaire was considered an appropriate and practical assessment methodology.

Despite the acknowledged limitations of self-report surveys and questionnaires, they do provide comprehensive information in large scale studies, saving both personal, time, and money. Furthermore, the data provided is usually easy to process statistically. In sports injury research specifically, questionnaires answered either retrospectively or in connection with an accident can provide additional valuable information on circumstances surrounding the incidence, complementing medical records and documentations from hospital or emergency room settings. Also pain and health assessment by a non-clinical population is an important complement to clinical studies.

A strength in the data collection of 2001 and 2002 was that we met in person with the students and were able to assist when necessary and sort out any uncertainties. If an injury had occurred during the assigned recall period, we discussed the incidence, and checked that it was within timeframe and definition. Also questions concerning medical diseases and handicaps were at times discussed and confirmed with their teacher. It was also an advantage that we were able to visit some of the schools and see the students in their own environment.

A further important strength of the studies and the entire research project was how the collaborative work of the research team was able to test and document such a broad range of various features of students´ health, and that the students were assessed over time with essentially the same instrument. The combined data bank of information will be a valuable base for future studies and interventions.

**Injuries during physical activity**

The risk of sustaining an injury is, as earlier mentioned, inherent when being physically active. One important factor that differentiates young athletes from adults is growth. There are anatomical as well as biomechanical differences attributable to the growing skeleton and tissue, making children and adolescents susceptible to unique injuries and patterns thereof (Guy et al., 1999; Maffulli et al., 2000). At the time of growth spurt, when bones grow faster and are stronger than soft tissues, an imbalance between the strength of muscle-tendons and ligaments compared to the bones occurs. Children are more vulnerable and susceptible to unique injuries, for example at the epiphyseal growth plate and at muscle-tendon insertion sites (Micheli et al., 2000; Hawkins et al., 2001). Pubertal development is also associated with risk of injury since during growth spurt adolescents usually loose some of their flexibility, coordination and endurance (Bernhardt, 2001; Hawkins et al., 2001; Michaud et al., 2001).

Variations in study designs, methodology, population, and injury definition employed makes it difficult to compare results from different studies. However, most commonly, an injury definition includes an anatomical tissue diagnosis, medical treatment required and/or time lost from sport participation (Noyes et al., 1988). In Study I we have defined an injury as a traumatic incident during physical activity at school or during their leisure time, that made them interrupt their activity and seek medical attention by an adult, such as a physical education teacher, trainer, parent, school nurse, doctor, and/or dentist. We asked the students about the diagnosis and treatment given to them, and we have concentrated on time lost from sport when discussing the

severity of the injury. In view of the fact that definition and time recall was accounted for in 2001 when discussing the injuries with the students, the increase of reports in 2004 may possibly be explained by the absence of this dialogue. However, the actual increase may also be attributed to the fact that rate and severity of injuries is known to increase with age (Zaricznyj et al., 1980; Abernethy et al., 2003a).

Location of (lower extremities), type of (strains and sprains) as well as mechanism of injury (a fall) was in our study similar in rate to those described in other studies (Tursz et al., 1986; de Loes et al., 1990; Sorensen et al., 1996; Brudvik, 2000; Purvis et al., 2001; Adirim et al., 2003). Most injuries occurred during free play and unorganized sports activities, which also is in agreement with others (Hergenroeder, 1998; Purvis et al., 2001).

In the base study, the injured students represented all estimated physical activity levels and their injuries reflected the winter months´ adherent activities with many skiing, snow board and skating sports (23 % of the leisure time activities) included. In the follow up study more injuries were reported by those very active in organized sports. Prevalence of injuries sustained in this setting increased with age from 10 % of the 12 year olds in 2001 to 47 % of the 18 year olds in 2004. When comparing if injured while training or during a game/match situation 9 % of the 12 year old reported the game/match situation and with an increase to 18 % for the 15 and 18 year old students.

School students in our study ranked ball games as one of their favourite activities during PE class. This fact was reflected in time spent playing ball during class (grade 3: 21 % and grade 9: 35 % of their lessons) and also reflected in the high number of injuries sustained while playing, and especially for girls. Since there is, at these ages, a great disparity in size between opposing players, this may become a risk factor in team contact and collision sports, and may further impose a problem in a coeducational setting during physical education class where boys and girls are grouped together. Participation in high skill and high risk sports without yet having the necessary complex motor skills may also be a risk factor. Again, as previously noted, the variety of size, maturity and skill level in a class or team is an added problem for the PE teacher and trainer to recognize and juggle (de Loes et al., 1990; Kelm et al., 2001). Grouping by size and skill instead of age has been suggested but is certainly difficult to systematize (Backx, 1989; de Loes et al., 1990; Micheli et al., 2000).

Every other student with a vision impairment reported that they did not use their glasses or lenses while exercising. This may possibly be a risk factor for injuries, as suggested by twice as many with an impaired vision reporting that they had been injured during physical education class ($p=0.009$).

For the acute traumas, most injuries sustained during school-sport activities were minor, in a physical sense, and they were often managed by physical education teachers, athletic coaches, school-nurses, parents or other adults caring for the child. These injuries, below the "tip-of-the-iceberg" (Last, 1963, cited in Backx, 1991) when comparing them to injuries recorded and collected at hospitals, can nonetheless cause pain, distress and become risk factors for future or recurrent injuries.

The most quoted risk factor for both adults and younger athletes is a previous injury. Ekstrand and Gillquist (1983) found in their prospective study that a minor injury in soccer was often followed by a more serious injury in the next two months. Playing while not fully recovered/rehabilitated, and even while still injured, can jeopardize the healing process (Micheli et al., 2000; Radelet et al., 2002). An injury causes loss of strength, endurance, flexibility, and proprioception at the site which adds up to multiple risk factors (Hergenroeder, 1998; Bahr et al., 2003). Especially sprains, dislocations, and stress injuries tend to recur (Lysens et al., 1986). In 2001, every other student (50 % of those injured) and in 2004, 40 % reported that they previously had injured the same body part. Reports also indicated that few had received rehabilitation, which heightens the importance of adequate treatment, proper rehabilitation, and guidelines for a safe return to previous activity level for this age group as well.

In the base study every other student and in 2004 one fourth of the girls and 17 % of the boys reported that they at the time of their accident did not wear the protective gear or equipment recommended for their sport. Insufficient, faulty, and or badly fitted sports and safety equipment has been described to be a risk factor (Sahlin, 1990; Micheli et al., 2000; Adirim et al., 2003). Due to the high expense of such gear, these are often handed down but if damaged and ill fitted, they may harm the child more than protect (Williams et al., 1998; Lysens et al 1986). Consequently, children and adolescents should strongly be encouraged to use safety equipment that is in the proper working order. Securing safe playing fields, surfaces and eliminating hazardous obstacles close to the activities is also imperative when trying to exclude risk factors (Hergenroeder, 1998; Micheli et al., 2000; Adirim et al., 2003).

Education is often mentioned as one of the core factors for avoiding injuries among school children and young athletes. The coach/trainer, and PE teacher as well as parents to some degree, play an important role in adapting volume and intensity of training to the physical and maturity level of the child, as well as avoiding unrealistic demands (Gould et al., 2000). Teaching and encouraging children proper technique and skills, safe and fair play are essential. Coaches/ trainers and PE teachers should be well educated, not only being able to teach the right skills but also having knowledge of the developmental stages of youth and the disparity thereof within the age group.

Moreover they need to have knowledge of sports medicine injury care and first aid so to limit the consequence of injury through proper immediate treatment (Williams et al., 1998; Purvis et al., 2001; Peterson et al., 2001; Radelet et al., 2002; Adirim et al., 2003). Deficiency in knowledge of sport injury care among teachers and coaches in Ireland was demonstrated in a study by Abernethy et al (2003b).

An important aspect, not necessary related to risk of injury in sports participation, but rather the risk of not being part of sports, or chosen to be part of can be the biological age factor. Early maturation with increased weight, height, and muscle strength may favour some children early on and disfavour others, who may have the talent and eventually surpass their friends if they are not already benched out by coaches and trainers.

**Pain and perceived health**

Little is known about how pain affects the growing child and historically there has been a widespread misconception that children, due to their "underdeveloped cognitive capacity," did not perceive pain in an adult manner (Singer et al., 2002). Subsequently their pain was often poorly assessed and cared for (Committee on Psychosocial Aspects of Child and Family Health, 2001; McClain, 2002). Parental reports of children's pain has been a common practice in the past (Naish et al., 1951; Vahlquist, 1955) and at times still is (Raat et al., 2002; Abernethy et al., 2003a; Roth-Isigkeit et al., 2005; Strine et al., 2006).

As part of the students' questionnaire-based rating of health, they were asked to report how often they suffered from pain, and specifically headache, abdominal pain and musculoskeletal pain. In our studies we defined pain as a constant or recurrent sensation not attributed to an

injury/accident or to their knowledge a medical disorder, which is similar to definitions used by others (Mikkelsson et al., 1997b; Hunfeld et al., 2001). The recall period of our students' pain perception was the same as for injuries and perceived health i.e. early January until the testing dates in March/April (10-14 weeks). The same period was used for the study in 2001 as in 2004 so as to exclude any seasonal differences affecting the perception. The definition of chronic pain is that it is continuous or recurrent for approximately three months duration (Merskey, 1986, 1994).

Prevalence of frequent (weekly) pain, quoted in the scientific literature for school-age children, demonstrate sums rating from 6-47 % for headache, 10-25 % for abdominal pain, and 5-20 % for musculoskeletal pain, which is within the range of our findings (Bandell-Hoekstra et al., 2001; Petersen et al., 2003). Differences in pain definition, methodology applied and recall periods ranging from pain ever, past year to last month, week or point prevalence are factors influencing prevalence rates and are important to consider when comparing results from other studies (Goodman et al., 1991). Moreover, many studies have a specific focus on a certain health problem which may explain even higher prevalence rates compared to other studies. Questions addressing pain, headache and sleeping problems etc. were in our studies only part of a wide selection of questions, which may have lessened the attention of each given part. This procedure might have minimized the so called "Hawthorn effect" (first recognized during late 1920 at Hawthorne Works, Chicago USA, where industrial workers increased their productivity when they realized they were being observed). This impact on reports, as well as how issues of pain, disability and disease can affect prevalence rates (of low-back pain), was commented on by Balagué et al. (2003).

Consonant with our findings as well as both national and international studies prevalence of pain increases with age and is more common among girls (Brattberg, 1994; Borge et al., 2000; McGrath et al., 2000; Perquin et al., 2000; Hunfeld, 2001; Fichtel et al., 2002; Hakala et al., 2002; Petersen et al., 2003; Roth-Isigkeit et al., 2004). Studies have verified a possible sensitivity to added sites of pain although with no special pattern of clustering in school-age children (Abu-Arafehet al., 1996; Mikkelsson et al., 1997a; Santalahti et al., 2005). Their pains are many times of lengthy duration and with frequent recurrence thereof (Mikkelsson et al., 1997a; Perquin et al., 2003; Brattberg, 2004; Roth-Isigkeit et al., 2004). Furthermore, there has been an increase of pain reports since years back (Bandell-Hoekstra et al., 2001; Hakala et al., 2002; Santalahti et al., 2005).

In a recent Swedish study, Petersen and co-workers (2003) reported on high prevalence of pain as well as tiredness among preadolescent and school children even as young as age 6.

Different recall time of back pain, varying from "ever experienced pain" to "pain today", makes comparisons between studies difficult. Although reliability is likely to decrease with a longer recall period, most studies show an alarming number of non-specific back pain, as well as recurrent and continuous pain in school-aged children (Balagué et al., 1999). The majority of back pain studies show an increase with age (Kristjánsdóttir, 1996; Taimela et al., 1997; Balagué et al., 1999; Hakala et al., 2002; Watson et al., 2002) as well as an increase in total prevalence over the past fifteen years (Hakala et al., 2002), in addition to higher prevalence among girls (Brattberg, 1994; Balagué et al., 1999; Harreby et al., 1999; Hakala et al., 2002, Watson et al., 2002; Kovacs et al., 2003). The increase of pain with age was confirmed in our study. Even though self-reported pain often is benign, the fact that students report persistence of pain over time and even years is noteworthy (Mikkelsson et al., 1997a; Perquin et al., 2003; Roth-Isigkeit et al., 2004). Prevalence of low back pain at a young age has been suggested as a possible indicator for back pain later in life (Harreby et al., 1999; Hakala et al., 2002), hence the reported increase may signify an alarming future. Our data showed that 55 % of the girls and 39 % of the boys who reported point prevalence of back pain in 2001 did so again in 2004.

Conflicting findings have been published on low back pain and levels of physical activity in school age children. Balague et al. (1988) found an association between physical inactivity and low back pain. Brattberg found no association between pain (back pain) and headache with physical activities in her study from 1994. This study provided no documentation of how levels of physical activity were assessed, which makes it hard to evaluate the findings (Brattberg, 1994). However, other studies have also found an association between low back pain and adolescents highly active in competitive sports, depending on the type of, and the intensity of activity, as well as whether a trauma had occurred (Balagué et al 1999, Harreby et al., 1999). Highly physically active students reported more low back pain as well as a co-occurrence of limb pain but less non-musculoskeletal pain as headache and abdominal pain in Kujala et al´s study from 1999. Our data was for both years inconclusive for showing an association between point prevalence of pain and being physically active or not.

Medically inexplicable physical symptoms, when medical origin and pathological explanations for pain are not apparent, are common among school-age children and students. Their complaints

are often recurrent, sometimes multiple and difficult to diagnose and treat and are sometimes classified as psychosomatic (Campo et al., 1999; Bruusgaard et al., 2000) or "biopsychosocial", since somatic, psychological and social factors are believed to interact (Berntsson et al., 2000).

Several risk or casual factors for pain have been suggested and studied, though the findings have remained controversial. Examples of such factors are the influence of stress, socio/economic factors, and educational achievements, the monotonous repetitive movements of electronic games, family history of pain, body mass/size, anatomical abnormalities, level of physical activity and fitness, strength and flexibility, as well as mental stability (McGrath, 1994, 1995; Vingilis et al., 1998; Balagué et al., 1999; Harreby et al., 1999; Berntsson et al., 2000; Borge et al., 2000; Hakala et al., 2002; Kovacs et al., 2003; Cardon et al., 2004).

Psychosocial and emotional factors were more explanatory to pain than physical in Brattberg´s study (1994). The emotional and psychological impact on pain was also pointed out by Waters et al. (2001) and Szpalski et al. (2002).

Most epidemiological studies on perceived health and pain with a population of young students are, as ours, retrospective and the information given is often quantitative (prevalence of symptoms) rather than qualitative (impact of symptoms) (Goodman et al., 1991; Haugland et al., 2001b). The students in our studies were asked about the frequency and duration of their pain symptoms. The intensity of their pain was not addressed, which we on one hand recognize as a limitation of our studies. On the other hand, with reference to van den Brink et al. (2001), estimates of intensity may best be done in prospective rather than retrospective studies. Van den Brink et al. (2001) have shown, at group level, that pain (headache) frequency was equal when assessed prospectively as well as retrospectively. However, pain intensity and duration was higher and overestimated in retrospective questionnaires compared. The same finding has been reported by Hunfeld et al. (2001).

**Longitudinal results**

Girls´ perceived well-being, as defined by various pain and perceived health variables, showed a continuing increase of frequent complaints over the three year period. Boys reported fewer complaints with increasing age, with the exception of tiredness, which increased for both genders with age. Over half (56 %) of the girls and two-thirds (67 %) of the boys reported no frequent

complaints either year. When comparing change in assessment at grade level, with an unrelated sample most variables were rated the same as three years earlier by the same age group.

The number of students reporting frequent pain as headache: 13 % (range for age and gender 5-24 %), abdominal pain 9 % (range: 2-19 %) and musculoskeletal pain 10 % (range: 4-17 %) may by some be regarded as small. Nevertheless, with a cut off point for frequency (daily to once a week) and persistence (three months) both in 2001 an 2004, it is still noteworthy at these ages with this prevalence in a non clinical school-age population.

Since we found significant gender differences in the base study, the role of gender was chosen as an explanatory factor in the regression model. We also tested for interaction with age, physical activity level, and stress. Stress was shown to be the most important explanatory factor for frequent reports of pain and perceived health complaints, outweighing both gender and age. Thereafter, gender (being female) was related to all variables but tiredness, where grade level (increasing age) was second to stress. Physical inactivity was also strongly related to all variables, but headache and musculoskeletal pain. The co-occurrence found for stress with rated pain and perceived health in 2004 is important and especially since data from the same students show that frequent stress, i.e. daily to at least once a week, was most often perceived by the physically inactive students (36 %) compared to the active (20 %) ($p<0.001$) as well as for those classified as inactive in 2001 and 2004 (See Table 6 in Study III).

Hence, stress introduced as an explanatory factor, provided partial explanation, and confirms the suggestion that the relationship between stress and perceived well-being among adults is also true for the younger population, and especially for girls. Teaching school age children stress management, stress release techniques and stress coping strategies such as "problem focused coping" and "emotion focused coping" first described by Lazarus and Folkman (1984) and later addressed in studies by e.g Bandell-Hoekstra and colleagues (2000) and Pincus and Friedman (2004), may be an important preventive initiative in schools.

Our research findings, and those cited above by others, show a continuing need for longitudinal epidemiologic research. The three year time period is a rather short interval in a lifespan, but at these ages, with rapid growth and maturation, it is of importance to investigate differences at various age levels for early recognition, and possible preventive measures and proper pain treatment during the school-age years.

Finally, as have been pointed out throughout the different studies, even though the longitudinal results may reflect a causal link any associations, correlations or other causal relationships may merely be speculated upon due to the cross-sectional design of the studies in this thesis.

**Age and Gender differences**

Prevalence reports from scientific studies are as always influenced by the individual's subjective experience, tolerance, and memories of pain and injury (McGrath, 1994; von Baeyer et al., 2004). Perception differs not only with age and gender or from one person to another, but also within an individual from time to time depending on circumstances. This fact influences answers given in questionnaires and also data collected in clinical settings since reasons for seeking medical care for injuries and pain problems vary as well.

Men and boys are said to usually participate more vigorously and with more aggression in sports, in addition to taking part in more high risk sports, which will make them more prone to injuries (Backx, 1989). This fact is also documented in prevalence reports of sports injuries among youth, showing that boys are more often injured than girls (Tursz et al., 1986; Williams et al., 1998; Brudvik, 2000; Michaud et al., 2001) and their injuries are more severe than girls (Sahlin, 1990; Williams et al., 1998). However, studies have shown that the injury rate is similar for girls and boys when time exposure is equal, as during PE class and in college sports (Hergenroeder, 1998). When comparing female and male participation in high school sports, girls were more injured than boys in soccer and softball and especially knee injuries were more frequent in girls' basketball and soccer compared to boys playing the same ballgames (Powell et al., 2000). Boys were injured most often in team sports such as ice hockey and soccer, and girls in skating and riding in the study of sport-related injuries in children by Kvist et al. (1989). For different rates in self reported injuries there is also the reporting factor, i.e. boys are less likely to report a minor injury (Williams et al., 1998).

For gender differences in pain girls usually assess their pain more severely, using a visual analogue scale (VAS), than boys (McGrath et al., 2000; Hunfeld et al., 2001; Roth-Isigkeit et al., 2004) as well as reporting a greater pain affect (McGrath et al., 2000; Roth-Isigkeit et al., 2005) or functional disability in connection with their pain (headache) (Fichtel et al., 2002). For both genders, societal influences on reporting styles and expectations, as well as global self-esteem, past experiences and other contextual and demographic facts can further influence prevalence of

pain (Anand et al., 1996; Vingilis et al., 1998; Haugland et al., 2001a). Our findings of high prevalence of pain and health complaints among girls in the 12th grade may possibly be explained by that the time of assessment coincided with their final semester at school, which may be perceived as stressful.

Other studies have found that multiple somatic complaints were related to emotional disorders in girls, and with more disruptive behaviour disorders and school absentees in boys (Mikkelsson et al., 1997b; Egger et al., 1999; Santhalati et al., 2005).

Also, maturation and cognitive development can change the concept of pain, from a more concrete perceptual perspective in younger students, to a more abstract emotional/psychologically oriented perspective in older students, which may influence prevalence rates (Gaffney et al., 1986). The students in this thesis are referred to using their chronological age, which we acknowledge as a limitation since the biological age shows great disparity both between and within gender at these age groups (Rhee, 2005). The influence of pubertal maturation on physical symptoms would have been valuable but for the purpose of this study it was regarded as being too intrusive for the students.

However, it must be emphasized that a majority of students go through the developmental transition periods from childhood to adolescence and early adulthood without any perceived pains and health complaints. They were in our studies and for the assessed time periods (Jan-March in 2001 and 2004) for no frequent pain; 59 % of the girls and 74 % of the boys, and for no frequent perceived health complaints 52 % of the girls and 60 % of the boys.

**Child-parent agreement**

The Swedish Bureau of Statistics was commissioned in 1983 to develop a statistical surveillance system covering the conditions of living for children and youth (Jakobsson et al., 1991). The data provided was often based on the living conditions of their parents and rarely included observations and information taken directly from the child. Children's perceived health and especially their complaints has also for long been based on parental reports which may have influenced prevalence rates when shifting the methods to actually asking the child herself/himself. Somatic complaints and pain, in children and adolescents are increasingly common, but has been under-recognized and under-treated in the past. However, this possible explanation has to the best of our knowledge not yet been confirmed.

Discrepancies between child and parent responses may be due to lack of communication, the child's feelings of awkwardness about their own physical state, social desirability, "playing tough", etc. In addition, the affect their health has on daily life may not be perceived as significant for child and parent. Fathers in our study had a higher agreement with their daughter or son (seven variables with agreement above 0.5 (Kappa value)) compared to the mothers (two variables with an agreement above 0.5). Differences in reports from mothers and fathers depending on whether reporting and rating daughters or sons was an interesting finding unfortunately limited by the disproportionate number of mothers who responded versus fathers.

Our findings of parental underreporting were recently affirmed by Santalahti (2005) who showed that 14 % of children's report of headaches and 30 % for abdominal pains, on a daily basis, were reported by the parents as non existent. This further strengthens the suggestion that when assessing the perceived health and well-being of students, their own expressions should be the basis for the data collection and analysis rather than relying entirely on parental reports.

# CONCLUSIONS

**Study I**

- Our findings showed that self-reported injuries sustained during physical activities, were common, but most were of minor severity.
- Twice as many with an impaired vision reported that they had been injured during physical education class. Furthermore, every other student with a vision impairment reported that they did not use their glasses or lenses while exercising, which indicates this being a preventable intrinsic risk factor for injuries
- Many of the injured students reported that they did not use the recommended protective equipment at the time of injury. Thus, encouraging the use of protective gear is imperative.
- The high rate of injuries during physical education class and leisure activities accentuates the need for effective guidelines for injury prevention and development of safety education programs in schools as well as the value of both knowledge and ongoing sports medicine first aid education for physical education teachers, school nurses and coaches or trainers.
- Every other student had previously injured the same body part, and their rehabilitation was often unsatisfactory. Establishing an ongoing dialogue and collaboration between doctors, physical education teachers and the sports club trainer is valuable after a young athlete has been injured, giving guidelines for a safer return to activity and to avoid a re-injury or another injury.

**Study II and III**

- The high prevalence of pain and perceived health complaints in our studies, especially among girls with increasing age, is a matter of concern and needs to be acknowledged.
- School children ought not to be regarded and treated as a homogenous group but rather grouped by age and gender in analyses and reports since frequent pain rates ranged within our studies between 2-24 % over age and gender.
- The co-morbidity found between stress and other pain and perceived health complaints suggests that students already at young ages need to be taught ways to cope with and handle their stress.

- The present study indicates a positive correlation between positive perceived health and level of physical activity, but the actual causal link has yet to be confirmed.
- The significant differences in prevalence of headaches, stress, and tiredness between schools merit increased attention to the working environment of the students.

**Study IV:**

- When assessing perceived health among school children and students, in a non-clinical setting, their reports should form the base of the data collection rather than relying entirely on parental reports.

## CONCLUDING REMARKS AND FUTURE PERSPECTIVES

A common question when summarizing the findings of a study, scrutinizing the methods and limitations is: Would you do it differently if you had the chance to redo it all?
Though I am obviously being partial, I think the initial idea and master plan for this multidisciplinary study was very well designed by the scientific leaders. Thereafter with combined efforts from the entire research team, personnel at The Swedish School of Sport and Health Sciences, participating schools and first and foremost all the students, the organization, and logistics worked remarkably well. Though hectic at times, all those weeks of testing and later traveling throughout Sweden, visiting participating schools, will always be treasured as very fond memories that I am grateful for having been part of. Of course improvements can always be found but they are limited as so often to available funds for the project.

Initially, our vision was to cover a wide enough breadth to try to capture the essence of school students´ health. In doing so we may have lost depth in some areas of information.

In the future it would be valuable to combine our epidemiologically collected quantitative data with other measurements and qualitative research techniques such as interviews and observations, with same subjects, for a deeper understanding of concepts and underlying factors affecting the students' perceptions and reports.

Securing validity and reliability of the research methods by combining techniques (for instance when assessing physical activity, with accelerometers etc. and when recording sports injuries checking with medical records) would be valuable.

Risk factors for injuries have been discussed in relation to physical activities in Study I and in the introduction, but there is also a call for identifying possible risk factors for pain and possibly identifying the pain-prone individual so that preventive measures can be taken and care given as early as possible. It is especially important to identify students with multiple sites of pain and recurrences at younger ages and in particular, if there is a trend for early onset of pain symptoms.

Noteworthy are the increasing complaints by girls, but caution most be taken as to boys reports in that the methodology chosen may possible have biased the results and that boys´ ill health is expressed elsewhere and in other ways. Discrepancies in reports from mothers and fathers

depending on gender of child were an interesting finding that also can be explored in future studies.

Since prevalence of pain and health complaints varied between schools, future studies are essential for examining school children's working environment. The influence of size of class, academic stress, and other factors remains to be shown.

Moreover, explanation for possible socio-economic and regional differences in reports of pain and perceived health complaints warrants further studies.

Future intervention studies are essential for examining the actual causal relationships among the health variables, with physical activity and with students' health related behaviours in addition to factors yet to be determined.

The focus in research studies, as ours, is often on unhealthy parameters. It would be interesting to instead ask the students questions with a positive, salutogenic (Antonovsky, 1996; Lindström et al., 2005) approach and perspective, and assess their subjective well-being conceptualized by questions such as how often have you laughed or felt happy and content during the past three months.

Interventions of medical or non-medical character are difficult in large scale nationwide studies, but epidemiological prevalence studies are important in that they may create awareness of the situation. The essence of our work, and the broad perspective taken in the studies, was the attempt to try to grasp, understand, and conceptualize the present health of school children, for better and for worse. The information given from this and other studies in the SSH research group are central for hopefully alerting political decision makers not to further cut back on the school budget, but rather to provide economic resources for improving the working environment of school children.

This thesis is hopefully not the end of the School-Sport-Health (SSH) project, but rather the start for continuing longitudinal studies and interventions with multidisciplinary approaches. Though there were 1,908 answers and reasons for their reports and assessments, the message they are sending is important for preventing ill health in the future and creating a healthy environment at school, on the sports fields and wherever the adults of the future are busy growing.

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# APPENDIX