11. Children and young people

Author

Ulrika Berg, MD, PhD, Department of Woman and Child Health, Paediatric Endocrinology Division, Karolinska Institutet and Astrid Lindgren's Children's Hospital, Stockholm, Sweden

Summary

Our society demands less and less everyday physical activity, such as that in connection with transportation to and from work or school. Some places, where children previously played freely are now judged to be dangerous in various ways. There is also a concern that children and young people, just like adults, are becoming less physically active, which could lead to health problems as early as their childhood years and/or as adults.

This chapter comprises a summary of what we currently know about children's physical activity level and what effects various types of physical activity can have during the childhood years and/or at an adult age. In conclusion, a summary is provided and the Swedish and international recommendations that currently exist for physical activity among children are presented. Evidence exists that the physical activity level of children can be influenced. This area is to some extent controversial and there is a lack of longitudinal studies.

Background

Physical activity is defined as "all types of physical movement done by the skeletal muscles that increases energy expenditure", in other words, virtually all the time that the child is not sleeping or completely still. The physical activity can be spontaneous, planned and/or organised. The spontaneous physical activity can be comprised of play or transportation. Our society demands less physical activity from people in connection with transportation, for example. Some places, where children previously played freely are judged to be dangerous in various ways. There is a concern that children and young people, just like adults, are becoming less physically active, which could lead to health problems as early as their childhood year and/or as adults. In this context, it can also be mentioned that Sweden is among the European countries (of a total of 18) that have the least guaranteed time dedicated to the school subject of sports and health per week.

How much do children and young people exercise today?

Surveys, pedometers (step counters), accelerometers, the doubly labelled water method and heart-rate monitoring are some methods used for activity registration among children (1). Validity, reproducibility and practical implementability are discussed and a combination of various methods is recommended. For example, surveys have the advantage of being able to be implemented in large groups, but the results should be interpreted with some caution, particularly among children under the age of 12 (2).

Within the scope of the European Youth Heart Study (EYHS), a total of 800 Swedish children (ages 9–10 and 15–16, respectively) were studied with accelerometers during the 1998–1999 school year (3). The "health-enhancing level" of physical activity was defined based on energy expenditure and was rooted in the adult recommendations current at the time (30–60 minutes of daily activity, corresponding to a brisk walk or more strenuous). For four days, all physical activity during the waking hours was registered. The group of 9–10 year-olds were active at a health-enhancing level an average of 200 minutes a day. Those achieving 60 minutes of such activity per day comprised 85% of the boys and 65% of the girls. A decreasing level of physical activity in the older group confirms data from several other studies. The girls were less active at a health-enhancing level than the boys in both age groups, which also agrees with previous studies conducted with various types of methodology. However, there was no gender difference in terms of sedentary time (not including night-time sleep), which on average was 284 minutes per day (younger group) and 432 minutes per day (older group). Differences in the physical activity level only explained the differences in maximal oxygen uptake (aerobic fitness) to a limited extent, which confirms several previous studies that these two variables do not always correlate to one another (4).

In another study (5, 6), where step-counters were used as a measure of the physical activity level, Swedish 7–14 year-olds (n = 892) and 15–18 year-olds (n = 375) were studied. There was a wide spread of the degree of physical activity in all age groups. The majority of the 7–14 year-olds achieved a number of steps (8,000 per day) that corresponds to slightly more than 30 minute's of moderately strenuous activity/day. The degree of activity was lower among the 15–18 year-olds and this was especially clear among the boys.

Measurement of physical variables can be an indirect measure of how much children and young people exercise although it does not provide any detailed knowledge about the intensity. The maximal oxygen uptake has proven to have a correlation with the overall degree of physical activity among children and young people in some studies, but not in others (4). Consequently, it cannot be considered to always constitute a certain indirect measure of degree of physical activity (particularly if consideration is not made of the activity's intensity). It is difficult to draw any conclusions as to whether or not Swedish children's/adolescents' aerobic fitness has diminished over the years, but there are indications of this (3, 7, 8).

In one study, where the physical capacity of Swedish 16-year-olds was compared in 1995 and 1974, an increased body weight but not height and a greater bone strength probably related to this was reported. However, a lower aerobic fitness (running test) and decreased arm strength (8) were also observed. The young people also completed a questionnaire where they said that they were more active in their free time and members of various sports associations to a greater extent than the young people of 1974. At the same time, 70 per cent of the young people said that they were physically active less than one hour a day at moderate intensity (9). In a study of a total of 2,000 Swedish children in grades 3, 6 and 9 in 2001 ("the school project"), a somewhat complex view of children's performance capacity appeared (7). Here, a relatively wide spread is seen within the age groups. Clearly not all children are unfit and weak. However, there is a group of children of both genders and in all age groups that markedly distinguishes themselves from their contemporaries in a negative sense. A comparison was made with children studied in 1987 and it was found that strength and stamina in the upper body muscles had decreased and that aerobic fitness (maximal oxygen uptake) had decreased among the boys (the 16-year-olds were studied in this regard).

In a survey of children in 2001, the total time the children devoted to some form of physical activity was summed (10). A low level of activity was classified as such that "the child participates (and exercises extensively) during the school's physical education (PE) lessons twice per week, and also pursues some sport once a week and cycles/walks a maximum of 10 minutes a day". The level of exertion is not presented in detail. On average, many children in grades 6 and 9 said that they spent a somewhat extensive period of time pursuing physical activity. However, there was a high level of variation between the children in each age group. In grades 6 and 9, 2–4 children out of 10 reported a low or very low level of physical activity. In 2001, the Swedish National Institute of Public Health (SNIPH) and the Swedish National Agency for Education conducted a survey of 905 compulsory school and upper secondary school students from grade 8 up (11). In summary, 63 per cent indicated that they were physically active (defined as an activity causing one to become out of breath and sweaty, such as a fast walk) at least 30 minutes a day during a normal week. Those virtually completely physically inactive comprised 15 per cent (in other words, exercised less than two hours per week). In a study of 301 upper secondary school students in 1996, 26 per cent of the girls and 35 per cent of the boys said that they "seldom or never" performed any physical activity that made them sweaty and out of breath (12). The physical capacity was assessed through seven physical tests that were compiled into a physical index. The lowest physical index was in the young people in the practical programmes, especially the girls. This can be considered to be particularly serious since the young people who were training for professions with heavy physical loads had the lowest physical capacity (13).

There are few studies of the activity habits of preschool children. A Scottish study of 78 children (studied with accelerometers and the doubly labelled water method) showed that 5 year-olds were more active than 3 year-olds and that 5-year-old boys were more active than girls of the same age (14). Studies in the U.S. have shown that the degree of physical activity of 3–5 year-olds differs significantly between various day-care centres/preschools (15, 16). This was particularly clear for high intensity physical activity. The

physical activity at day-care centres comprised approximately 50 per cent of the children's total physical activity. In one of the U.S. studies, boys were more active at a high intensity than girls (16).

Studies have shown that children of physically active parents are more physically active than children of inactive parents (17). However, no certain correlation between the degree of physical activity during childhood and the degree of activity at an adult age has been shown (18, 19). Whether or not there is such a correlation for inactivity should be more closely investigated.

In summary, there are consequently indications that certain groups of Swedish children and young people are not physically active enough, which can at least partially explain decreases in physical activity. Girls are less active than boys and the degree of physical activity decreases from around the age of 11–12.

Effects of physical activity

Functional physical capacity, such as muscle strength and aerobic fitness, can be improved with strength and aerobic training, respectively. From a health perspective, the effects on bone mass, body fat and future risk factors ("risk indicators") such as cardiovascular disease are important to observe. Effects on the growing individual's motor, cognitive, emotional and social development should also be observed.

Studies of effects of physical activity on growing individuals demand special considerations. A capacity increase can sometimes be more due to natural maturation and growth than to physical exercise. For children with the same chronological age (13 years for example), the "biological age" (measured with variables such as growth rate, skeletal maturity, puberty development) can differ by several years, which naturally affects factors such as muscle strength. Adequate control groups are important. "Dose-response" is often difficult to comment on, since most studies have only studied a selected dose of physical activity and cannot comment on whether a lower dose would suffice to achieve health effects.

Effects on aerobic fitness

Aerobic fitness is based on several building blocks, both the central circulatory capacity (maximal cardiac output/oxygen uptake) and local muscle endurance (adaptation). Altogether, studies show that both of these components develop with increasing age, but are already trainable during the growth years. Maturity appears to be of significance to the effect on the maximal oxygen uptake (greater effect in older children and adolescents), but it has not been established exactly how (20). The magnitude of the dose required at various ages has not been studied in detail, but in several studies an increase has been observed after strenuous to moderately strenuous activity (such as aerobics, football/soccer) 30–60 minutes at a time, at least three times a week (20).

Many of the studies done with regard to the effects of aerobic fitness training in children and adolescents are relatively difficult to assess. Has the intensity of the training programme been adequate? What was the maximal oxygen uptake when the study was initiated? Age? Level of maturity? Longitudinal or cross-sectional study? Control groups? Moreover, the effect of training has been evaluated in different ways, such as by measuring the maximal oxygen uptake, the reaction to submaximal exertion and in some cases muscle biopsies or heart volume, making the results difficult to compare (20). As previously mentioned, the maximal oxygen uptake cannot be considered to comprise a certain, indirect measure of the overall level of physical activity, especially if the exertion intensity is not monitored (see the section on "How much do children and young people exercise today?").

Effects on muscle strength

Children are trainable and can increase their muscle strength by 14–30 per cent through training designed to train strength. The strength increase is considered to be an adaptation in the nervous system of the younger, prepubescent children where no effects on muscle mass could be seen. In addition to this, there is evidence of an increase in the muscle mass as a result of training during puberty. A training dose of two times per week appears to be adequate to achieve a strength increase. No heavy loads are needed; studies indicate that it is most effective to have a low load that is repeated many times (13–15 repetitions). Such training can be carried out with one's own body as resistance such as in various games or with light weights. There is little risk of injury with adequate guidance/instruction. Today, there are no official Swedish recommendations with regard to strength training for children (21–23).

Effects on cognitive function

Motor development is important to the child's overall maturity. In addition to the effects on healthy, normally developed children in terms of maturity, there is interest in motor exercise as a means to help children who have difficulties with language, perception, concentration and learning. Most children with considerable concentration difficulties have immature motor skills (24). In the "Bunkeflo project", the effect of daily, scheduled physical activity (one hour per weekday) was studied in children in grades 1–3. Children who had immature or late development of motor skills were also offered one extra hour of motor skill training per week. The children in the intervention group had improved gross motor skills compared with the control group, which only participated in the school's regular two PE lessons per week. Existing motor deficiencies did not subside on their own and the school's two regular PE lessons were not sufficient to stimulate the motor development of these students. In addition, the children in the intervention group performed better in mathematics and Swedish than the children who only had the school's regular two PE lessons per week. This was particularly

pronounced in the group of children assessed to have motor deficiencies that received extra motor skill training. Although the study can be criticised for not having been randomised, the results indicate interesting ties between physical activity, motor skill training and school performance.

For detailed reading, refer to Ericsson's intervention study concerning motor skills, concentration ability and school performance (25). There, three possible explanatory models are also described for the connection between motor skills/physical activity and cognition. The perceptual motor perspective focuses on the significance of the child's motor experiences to perceptual and sensory development, which is considered to be a prerequisite for cognitive processes. The neurophysiological explanation perspective is based on motor skill training/physical activity being able to entail changes in the nervous system's structure and function (such as neural connections, degree of alertness) that facilitate learning and memory processes. The psychological perspective is based on motor/physical activity inherently providing psychological changes (motivation, communication, social skills), which in turn facilitate learning.

In an article (26), Påske refers to a systematic analysis of the value of special, so-called perceptual training programmes (27): Sometimes, but not always, a modest, positive effect can be observed on the trained areas while "academic areas" (language, reading, mathematics) are unaffected by the training. The training has a moderate or no effect on the intellectual level of the normally gifted, but some (although moderate) effect on the mentally disabled in various stages. In the analysis, inclusion criteria, age distribution and frequency or the exact design of training were not presented. More well-described studies are desirable.

Effects on mood and mental health

In a Cochrane overview from 2004 (28), eight studies were included in a meta-analysis (children and young people ages 3–20). The results showed that regular physical activity had positive effects on self-esteem. The studies are heterogeneous. No certain conclusions can be drawn regarding the most effective type of physical activity, its intensity, duration or the context in which it was carried out. In a more recent Cochrane overview (29) that included 16 studies (children and young people up to age 20, but the majority ages 16 and up), the conclusion was drawn that regular physical activity has certain effects on both depression and anxiety, and that the intensity of the physical activity does not appear to have any significance. It is also noted that the studies have deficiencies and that there is particularly a need for more studies of children under age 16. Both studies in which physical activity was a part of a larger intervention and studies in which only physical activity was used were included in both of these overviews. Consequently, there are indications that regular physical activity has effects on self-esteem and the occurrence of problems of depression and anxiety, but it is too early to precisely describe the "dose".

Effects on the skeleton

High Bone Mineral Density (BMD) and skeletal girth reduce the risk of fractures in adults (30). Weight-bearing physical activity, such as callisthenics, running, tennis and ice hockey, can affect BMD and skeletal girth during the growth years. Peak bone mass is the highest amount of bone mass the individual stores in a lifetime. The greatest effects of physical training on the skeleton arise before puberty (30, 31). Since girls have an earlier puberty than boys (approximately two years earlier), training should be begun as early as age 7. The girls who did all-round physical education (PE) five days a week from 7 years of age had a higher bone mass at age 13 than those who had PE 1–2 times a week. In addition, data from this study indicates that continued PE maintained the higher bone mass all the way up to 18 years of age (32). In studies of former athletes, it is noted that the beneficial skeletal changes indeed remain for an extended period, but that they do not appear to still exist 30–60 years after the activity in question was finished. Continued activity at a lower level may possibly maintain the gain in BMD for at least approximately 15 years (30, 33). One Swedish study investigated whether or not the fracture risk later in life is lower in individuals with a high degree of physical activity during the adolescent years. Four hundred former male football and ice-hockey players (ages 60 and up, average age 71) and 800 age-matched controls were studied. The men in the former group, who had trained regularly between the ages of 13 to 36, indicated a lower number of fractures after age 35 than the men in the group that had not trained. Otherwise, the men indicated no differences in lifestyle when the study was carried out (34).

Girls intensely involved in sports who combine a high amount of exercise with insufficient nutritional intake and low body weight during the period up to peak bone mass can develop a delayed menarche or amenorrhea due to a disturbed hormonal balance and as a result of this also show various degrees of bone brittleness. This is one of many important reasons to pay attention to eating disorders in athletically active girls early on, including those who do not participate in organised sports (35). In this context, it should also be emphasized that insufficient energy intake relative to expenditure is not always due to eating disorders. It may be a matter of difficulties in combining long school days with frequent training sessions and adequate mealtimes.

Effects on obesity and risk factors for cardiovascular disease

Obesity and excess weight are becoming increasingly more common among Swedish children and young people (36) and increase the risk of developing cardiovascular disease at an adult age, regardless of one's adult weight (17). Obesity and excess weight are difficult to treat once established. Prevention is therefore of central importance in this context (36, 37). In weight-reduction programmes among already overweight children, dietary changes combined with increased physical activity provide better weight reduction results than dietary changes alone (38). Of course, the family should be involved in both the

prevention and treatment of excess weight. Correlations between physical activity and excess weight have been investigated with varying methodology and are difficult to assess on a whole (4, 17, 39, 40). In one of these studies (step-counter), the number of steps/day was linked to BMI in Swedish 6–12 year-olds and the interpretation of data was made such that a normal BMI required a minimum of 15,000 steps per day in boys and 12,000 steps per day in girls. (39).

Physical inactivity, such as watching television, is more clearly tied to excess weight in children (41). Whether or not this is a matter of selection, in other words that already overweight children choose inactivity or if watching television in itself causes excess weight, is somewhat unclear. "Screen time" of various types leaves less time left over for other activities, including spontaneous physical activity. Interestingly, a correlation between computer use and excess weight has not, however, been proven. The difference could possibly be due to watching television more often being associated with simultaneous energy intake, but this has not been proven in Sweden. Interventions in preschool/school have succeeded in reducing television watching (42, 43). In one of the studies (43), the reduction in the intervention group led to a lower BMI increase and less subcutaneous fat.

Atherosclerotic processes (causing fat deposits in the arteries) begin early in life (44). Excess weight during the growth years increases the risk of an accumulation of risk factors, which in adults has been shown to be of significance to the risk of developing cardiovascular disease (45). Such risk factors in children are usually called risk indicators and include, for example, increased blood pressure, hyperinsulinism (sign of lower insulin sensitivity) and elevated lipid levels. In the 9–10 year-olds and 15–16 year-olds studied in the European Youth Heart Study (EYHS), physical capacity (here, the maximal oxygen uptake) was more important than overall level of physical activity in preventing the occurrence of risk indicators for cardiovascular disease in these age groups (3). This indicates that physical activity of a moderate/high intensity may be important, because it is more likely to lead to a high aerobic capacity than activity of a lower intensity (see the section on aerobic fitness).

International studies indicate that a high level of physical activity during the growth years reduces the risk of developing cardiovascular disease at an adult age (46). Children/young people with a low aerobic capacity and other risk indicators for future cardiovascular disease have the most to gain from such training. One compilation (six prospective studies, only two of which included controls) has shown that aerobic training for 30 minutes three times a week for a minimum of three months can provide a blood pressure reduction in hypertensive children and young people 11–21 years of age (47). A training programme of 15 weeks, with an intensity of approximately 65 per cent of the maximal heart rate and an increasing duration from 20–45 minute per session and three times a week, was conducted on seven obese 13-year-old boys. The programme resulted in higher insulin sensitivity despite a maintained body weight and proportion of body fat (48). Effects of various training programmes on lipids in children are difficult to evaluate and no reliable conclusions can be drawn.

Are there risks of strenuous physical exercise during growth and maturation?

Discussions are currently ongoing with regard to whether or not very strenuous training without adequate recuperation can have negative effects on the growth and maturity of children and young people, including skeletal maturity and bone density, achieved final height and sexual maturity. Excessively strenuous training straining the back before the child is completely grown has also been called into question. Discussions concerning strenuous training are not included in this chapter. For more reading, refer to references 49 to 52 (49–52).

What do children and young people themselves say?

In the previously mentioned survey (53) covering 905 compulsory and upper secondary school students, some causes came forth as to why as much as 13–15 per cent of the students (15% of the girls in compulsory school!) seldom or never participated in physical education. This involved, for example, physical reasons, such as menstruation, problems with fainting and so on, but two thirds of the causes were of a psychological or social nature (boring, shy, disgusting). In addition, the young people's attitudes and evaluation of physical activity were investigated and they were asked what could get them to be more physically active in general. Here, several of the boys gave suggestions such that the school should support the students with access to the school's sports hall and more activities in the schoolyard during breaks. School teams were another suggestion – training buddies are important. The girls' motives for physical activity were most often items such as to feel good, become healthy, quit smoking and become thin faster. A varying content of the lessons in the subject of sports and health is noted as being important as well as support, encouragement and inspiration. It was mainly the upper secondary students who said that the economy could be crucial to the possibility of pursuing the form of physical activity that one wished. They also said that a lack of time due to studies can be an obstacle. The significance of cultural and ethnic factors to attitudes to physical activity can be investigated more closely.

Recommendations

Sweden supports the Nordic nutritional recommendations (54):

- A minimum of 60 minutes of physical activity is recommended every day. Both moderate and strenuous activity should be included.
- The activity can probably be divided up into several shorter sessions during the day.
- The activities should be as varied as possible to provide aerobic fitness, muscle strength, flexibility, speed, shorter reaction times and coordination.

This volume of physical activity agrees with international recommendations (55–58, 73). The U.S. recommendations from 2008 (73) recommend children and adolescents to do 60 minutes or more of physical activity daily. Most of the 60 or more minutes a day should be either moderate or vigorous aerobic physical activity, and should include vigorous physical activity at least three days a week. As a part of their 60 or more minutes of daily physical activity, children and adolescents should include muscle-strengthening and bone strengthening physical activity at least three days of the week. According to recent Finnish recommendations, children should be physically active for at least one to two hours per day. It is also emphasized that continued periods of sitting for more than two hours at a time should be avoided. Screen time with entertainment media should be limited to two hours per day (74).

Criticism has been expressed of currently making specific recommendations regarding physical activity in children and young people. As stated above, the available scientific data probably does not provide sufficient support to be able to specify an exact "dose" of physical activity that should provide all of the positive effects in all children and young people. The dose required to provide several positive effects later in adult life has also not been established and the existing level of physical activity is not known in various groups of children (59).

How can physical activity be promoted in children and young people?

- **Involve the family**. Children of physically active parents are more physically active than children of inactive parents (17).
- **Individualise the "prescription"**. It is desirable that there be several different alternatives to choose from. The choices/possibilities of following the recommendation are determined by individual preferences, gender, ethnicity, age, habits, family background, personality and so on. Contacts between sports/outdoor organisations and schools/healthcare are one possible solution (see "Idrottslyftet" or Sports Lift at www.rf.se for ideas).
- **Take the gender aspect into consideration**. Girls are generally less physically active than boys. The choice of activities can be affected by gender.
- **Increase the conditions for daily physical activity, such as in transportation**. Physically active "school commuting" can be of major significance to overall daily physical activity (60). "Walking school buses" mean that the parents arrange walking groups to school so that an adult always accompanies the children. Political efforts that affect the local environment so that it makes physically active transports possible, becomes attractive and encourages physical activity (61–63) are important here. The Government has charged the Swedish National Institute of Public Health to commence development efforts in this area (see www.fhi.se).
- **Pre-school/school-based interventions**. Utilise a combination of various methods. For ideas, see (63–65).

- **Healthcare-based measures**. There is a current lack of documented studies. Utilise a combination of various methods. For ideas see (64). Involving the family early on, such as in connection with health check-ups, may possibly be a way forward.

Children/young people and sports

In 2005, the Council of the Swedish Sports Confederation revised the sporting movement's conceptual programme, which is available in its entirety at www.rf.se (66). Some points concerning children and young people are briefly summarised below:

Children (ages 0–12)

- Sports should be playful, multifaceted and adjusted to the child's growth rate.
- Sports should be led by a leader with fundamental knowledge of children's physical, mental and social development.
- Children benefit from practicing several different sports and should have the right to do so in various associations.

Young people (ages 13–20)

General sports
- Consideration should be made of the individual's needs and circumstances.
- The transition between general sports and elite-focused sports should be gradual.
- The sporting movement should develop types of training and competition that meets the needs of boys and girls for general sports.

Elite sports
- Elite endeavour for those interested in doing so in socially safe ways.
- Competition activities should counteract exclusion.
- Leaders should be given the possibility of acquiring in-depth knowledge of physical, mental and social development.
- Ethical boundaries should be actively discussed (doping for example).

Special groups

Children with immature or late-development of motor skills

As yet, there are no official Swedish recommendations with regard to the identification and/or treatment of gross motor difficulties in children with immature or late development of motor skills without other anomalies (such as more or less visible motor disabilities). Proposals of measures in this area have been presented (25, 67).

Overweight and obese children

As previously mentioned, prevention is of central importance in this context. A combination of measures is necessary. An increase in the degree of physical activity is not enough on its own. A "decrease of physical inactivity" is a prescription that may be easier to follow than an "increase of physical activity" (68).

A guide in this context in terms of prevention comprises the national Swedish action plan for good eating habits and increased physical activity in the population that was prepared on behalf of the Government in 2005 (www.fhi.se). The objective in terms of physical activity in children is stated to be to:

"1. Increase the proportion of healthy children who are physically active for at least 60 minutes every day at a minimum of a moderate level , or a total of at least seven hours per week.
2. Reduce the proportion of children with a sedentary lifestyle."

In more intense organised "training sessions" for obese children, consideration should be taken to the child's current degree of excess weight. In a one-year programme, the Moderate Intensity Progressive Exercise Program (MPEP), the frequency, duration and intensity is gradually increased over time (every 10th to 15th week) (69). For an obese child, this can initially involve participating in one training session twice a week for 25 minutes with an intensity that is 50 per cent of the maximum oxygen uptake capacity. It should be emphasized that training programmes for obese and severely obese children should be administered in consultation with people knowledgeable in the area.

Children with asthma

The Swedish Paediatric Society's section for children and youth allergology emphasizes the importance of encouraging children with asthmatic symptoms to participate in physical activity. Detailed advice for the prevention, investigation and treatment of exercise-induced asthma is provided on the website (70). Increased physical fitness may contribute to psychological well-being and improved asthma control. In addition to the children with an allergic asthma, there are also children who have asthma symptoms in connection with exercise. Children with these symptoms quickly adapt and tend to avoid physical exertion. With greater knowledge and guidance, these children can be helped to break this pattern. Good basic medication is important. Symptoms are easily triggered by running, less so by cycling and least by swimming. Children who already have been diagnosed with asthma, who try to participate but cannot do as much as others and have coughing attacks upon exertion are recommended to consult a school nurse or doctor for evaluation. For known asthma, the following are recommended:

A. If preventive bronchial dilation medication is prescribed, it should be taken approximately 15 minutes before the sports lesson/training session.
B. Warming up is important. Let the participants warm up slowly for 10–15 minutes so that the pulse is gradually increased.

C. The actual training session, or parts of it, may preferably consist of so-called interval training, in other words short (a few minutes) intense sessions interspersed with less strenuous exercises. This can then be followed by more continuously strenuous exercises as long as symptoms do not appear.
D. Winding down is also important. Conclude the session over approximately 5–10 with exercises that slowly lower the pulse.
E. If the boy/girl has symptoms, make sure that he/she winds down properly.
F. For more severe symptoms, it is important as under E that the bronchial dilation medicine be taken and that he/she can rest, preferably sitting with the arms resting on the knees. If the symptoms do not subside within a few minutes, see to it that he/she is given a new medicine dose and that medical help is summoned.

For additional recommendations regarding physical exercise see (70).

Children with diabetes mellitus type 1

It is desirable to create conditions for better and safer physical activity for children/young people with diabetes. In an updated care programme for diabetes, which according to the plans should be presented in 2007, a special section on sports and diabetes will be included (Peter Adolfsson, Paediatrician, Queen Silvia Children's Hospital, Personal Communication).

Have methods of promoting physical activity been evaluated?

A systematic review of the scientific literature on various methods to promote physical activity was published by the Swedish Council on Technology Assessment in Health Care (SBU) in 2007 (64). The review included 24 studies of children and young people, of which 21 were school-based and three were healthcare-based. Eleven of the studies were considered to have sufficient scientific evidence to form the basis of the conclusions regarding children and young people:

1. The development of the school subject of sports and health, such as through greater investment in health education, educational materials and teacher training, leads to 5–25 per cent more physical activity during sports classes. This applies to boys to a higher extent than to girls (strong scientific evidence).
2. School-based interventions that comprise multiple components, such as teacher training, changes in curricula, extra activity sessions during class time and/or breaks, support in behavioural change, strengthened health education and the involvement of parents, have a positive effect on the physical activity of children and young people during the school day and in some cases also during free time (moderately strong scientific evidence).

3. School-based interventions directed at groups with an elevated risk of cardiovascular disease lead to approximately 10 per cent more physical activity (limited scientific evidence)."

For details and references, refer to (64) where the entire report is available. One can also refer to a compilation of systematic overviews concerning school-based methods to promote health and prevent disease in children and young people, which shows that school-based methods can be effective, particularly to promote mental health, good eating habits and greater physical activity (71). According to the Swedish curriculum, "schools should strive to offer all students daily physical activity in the scope of the entire school day" (72).

Accordingly, it was confirmed that children's physical activity level can be affected and that there is a need for more longitudinal studies in the area, particularly with regard to healthcare-based interventions.

Conclusion

There is scientific evidence of several positive effects of physical activity among children and young people. It is also possible to influence the physical activity level in children. There is a need for more studies in the area. Feel free to contact the author to report non-published interventions/experiences (ulrika.berg@ki.se).

Acknowledgement

Thanks to Ingunn Fjørtoft, M.D., Telemark University College, Notodden, Norway, for constructive observations and advice.

References

1. Sirard JR, Pate RR. Physical activity assessment in children and adolescents. Sports medicine (Auckland, NZ) 2001;31:439-54.
2. Brettschneider W, Naul R. Study on young people's lifestyles and sedentariness and the role of sport in the context of education and as a means of restoring the balance. Final report. Paderborn: University of Paderborn; 2004.
3. Hurtig Wennlöf A. Cardiovascular risk factors in children. Stockholm: Karolinska Institutet; 2005.
4. Ekblom . Physical fitness and overweight in Swedish youths. Dissertation. Stockholm: Karolinska Institute and Idrottshögskolan; 2005.
5. Raustorp A, Mattsson E, Svensson K, Stahle A. Physical activity, body composition and physical self-esteem. A 3-year follow-up study among adolescents in Sweden. Scandinavian Journal of Medicine & Science in Sports 2006;16:258-66.
6. Raustorp A, Pangrazi RP, Stahle A. Physical activity level and body mass index among schoolchildren in south-eastern Sweden. Acta Paediatr 2004;93:400-4.
7. Ekblom O, Oddsson K, Ekblom B. Health-related fitness in Swedish adolescents between 1987 and 2001. Acta Paediatr 2004;93:681-6.
8. Westerstahl M, Barnekow-Bergkvist M, Hedberg G, Jansson E. Secular trends in body dimensions and physical fitness among adolescents in Sweden from 1974 to 1995. Scandinavian Journal of Medicine & Science in Sports 2003;13:128-37.
9. Westerstahl M, Barnekow-Bergkvist M, Hedberg G, Jansson E. Secular trends in sports. Participation and attitudes among adolescents in Sweden from 1974 to 1995. Acta Paediatr 2003;92:602-9.
10. Engström L. Hur fysiskt aktiva är barn och ungdomar? [How physically active are children and adolescents?] Svensk Idrottsforskning 2002;11.
11. Strandell A, Bergendahl L, Kallings L. Sätt Sverige i rörelse 2001. Förskolan/skolan. [Get Sweden moving 2001. Preschool/school.] Report 2002;10. Stockholm: Swedish National Institute of Public Health; 2002.
12. Sollerhed AC, Ejlertsson G. Low physical capacity among adolescents in practical education. Scandinavian Journal of Medicine & Science in Sports 1999;9:249-56.
13. Sollerhed AC. Young today – adult tomorrow! Studies on physical status, physical activity, attitudes, and self-perception in children and adolescents. Malmö: Lund University; 2006.
14. Reilly JJ, Jackson DM, Montgomery C, Kelly LA, Slater C, Grant S, et al. Total energy expenditure and physical activity in young Scottish children. Mixed longitudinal study. Lancet 2004;363:211-2.
15. Pate RR, Pfeiffer KA, Trost SG, Ziegler P, Dowda M. Physical activity among children attending preschools. Pediatrics 2004;114:1258-63.
16. Finn K, Johannsen N, Specker B. Factors associated with physical activity in preschool children. The Journal of Pediatrics 2002;140:81-5.
17. Steinbeck KS. The importance of physical activity in the prevention of overweight and obesity in childhood. A review and an opinion. Obes Rev 2001;2:117-30.

18. Twisk JW, Kemper HC, van Mechelen W. The relationship between physical fitness and physical activity during adolescence and cardiovascular disease risk factors at adult age. The Amsterdam Growth and Health Longitudinal Study. International Journal of Sports Medicine 2002;23 Suppl 1:pp.8-14.
19. McMurray RG, Harrell JS, Bangdiwala SI, Hu J. Tracking of physical activity and aerobic power from childhood through adolescence. Med Sci Sports Exerc 2003;35:1914-22.
20. Mahon A. Exercise training. In: Armstrong N, Van Mechelen W (eds.). Pediatric exercise and science in medicine. 1. edn. New York: Oxford University Press; 2000.
21. Augustsson J, Wernbom M. Muskelstyrkeutveckling hos barn och ungdomar. [Muscle strength development in children and adolescents.] Svensk Idrottsforskning 2007;1:44-47.
22. Tonkonogi M. Styrketräning för barn – bu eller bä? [Strength training for children - good or bad?] Svensk Idrottsforskning 2007;1:38-43.
23. Malina RM. Weight training in youth-growth, maturation, and safety. An evidence-based review. Clin J Sport Med 2006;16:478-87.
24. Kadesjö B. Barn med koncentrationssvårigheter. [Children with concentration difficulties.] Stockholm: Liber utbildning AB; 1992.
25. Ericsson I. Motorik, koncentrationsförmåga och skolprestationer. En interventionsstudie i skolår 1–3. [Motor skills, concentration ability and school performance. An intervention study in school years 1-3.] Malmö: Malmö University; 2003.
26. Påske W. Motorik, perception och inlärning. [Motor skills, perception and learning.] Tidskrift i gymnastik och idrott 1989;116: 15-24.
27. Kavale K, Mattson P. ”One jumped off the balance beam”. Meta-analysis of perceptual-motor training. Journ of Learn Disabil 1983;16:165-73.
28. Ekeland E, Heian F, Hagen KB, Abbott J, Nordheim L. Exercise to improve self-esteem in children and young people. The Cochrane Library 2005;2. (Downloade 22 Oct. 2007: www.thecochranelibrary.com).
29. Larun L, Nordheim LV, Ekeland E, Hagen KB, Heian F. Exercise in prevention and treat-ment of anxiety and depression among children and young people. The Cochrane Library 2007; 2. (Downloade 22 Oct. 2007: www.thecochranelibrary.com).
30. Karlsson M. Fysisk träning under tillväxtåren ökar benmassan. [Physical training during the growth years increases bone mass.] Läkartidningen 2002;99:3400-5.
31. Karlsson KM, Stenevi-Lundgren H, Linden C, Gärdsell P. Daglig gymnastik stärker skelettet. [Daily callisthenics strengthen the skeleton.] Läkartidningen 2006;103:2979-80.
32. Valdimarsson O, Sigurdsson G, Steingrimsdottir L, Karlsson MK. Physical activity in the post-pubertal period is associated with maintenance of pre-pubertal high bone density. A 5-year follow-up. Scandinavian Journal of Medicine & Science in Sports 2005;15:280-6.
33. Nordstrom A, Olsson T, Nordstrom P. Sustained benefits from previous physical activity on bone mineral density in males. The Journal of Clinical Endocrinology and Metabolism 2006;91:2600-4.

34. Nordstrom A, Karlsson C, Nyquist F, Olsson T, Nordstrom P, Karlsson M. Bone loss and fracture risk after reduced physical activity. J Bone Miner Res 2005;20:202-7.
35. Carlsson C. Ätstörningar. En kunskapsöversikt. FoU-rapport. [Eating disorders. A knowledge overview. R&D report.] Stockholm: Swedish Sports Confederation 2004;1. (Downloaded 22 Oct. 2007 www.rf.se).
36. J Perlhagen, Flodmark CE, Hernell O. Fetma hos barn. Prevention enda realistiska lösningen på problemet. [Obesity in children. Prevention only realistic solution to the problem.] Läkartidningen 2007;104:138-41.
37. SBU (Swedish Council on Technology Assessment in Health Care). Förebyggande åtgärder mot fetma. En systematisk litteraturövrsikt. [Preventative measures against obesity. A sytematic literature review.] Stockholm: SBU; 2004.
38. Epstein LH, Wing R, Koeske R, Vaoski A. A comparison of lifestyle exrecise, aerobic exercise and calisthenics on weight loss in obese children. Behav Ther 1985;16:345-56.
39. Tudor-Locke C, Pangrazi RP, Corbin CB, Rutherford WJ, Vincent SD, Raustorp A, et al. BMI-referenced standards for recommended pedometer-determined steps/day in children. Prev Med 2004;38:857-64.
40. Ekelund U, Aman J, Yngve A, Renman C, Westerterp K, Sjostrom M. Physical activity but not energy expenditure is reduced in obese adolescents. A case-control study. Am J Clin Nutr 2002;76:935-41.
41. Rydell A, Brennberg S. TV-konsumtion och barns hälsa och anpassning. [TV consumption and children's health and adaptation.] R 2004:24. Stockholm: Swedish National Institute of Public Health; 2004.
42. Dennison BA, Russo TJ, Burdick PA, Jenkins PL. An intervention to reduce television viewing by preschool children. Arch Pediatr Adolesc Med 2004;158:170-6.
43. Robinson TN. Reducing children's television viewing to prevent obesity. A randomized controlled trial. JAMA 1999;282:1561-7.
44. Berenson GS, Srinivasan SR, Bao W, Newman WP 3rd, Tracy RE, Wattigney WA. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults. The Bogalusa Heart Study. The New England Journal of Medicine 1998;338:1650-6.
45. Williams CL, Hayman LL, Daniels SR, Robinson TN, Steinberger J, Paridon S, et al. Cardiovascular health in childhood. A statement for health professionals from the Committee on Atherosclerosis, Hypertension, and Obesity in the Young (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. Circulation 2002;106:143-60.
46. Eisenmann JC. Physical activity and cardiovascular disease risk factors in children and adolescents. An overview. The Canadian Journal of Cardiology 2004;20:295-301.
47. Alpert B, Wilmore J. Physical activity and blood pressure in adolescents. Physical activity guidelines for adolescents. Pediatric Exercise Science 1994;6:361-80.
48. Kahle EB, Zipf WB, Lamb DR, Horswill CA, Ward KM. Association between mild, routine exercise and improved insulin dynamics and glucose control in obese adolescents. International Journal of Sports Medicine 1996;17:1-6.

49. Lundin O, Swärd L. Ryggens disk – elitidrottarens achilleshäl? [Disks of the back - the elite athlete's Achille's heal?] Svensk Idrottsforskning 1999;3:15-7.
50. Malina RM. Physical growth and biological maturation of young athletes. Exerc Sport Sci Rev 1994;22:389-433.
51. Caine D, Lewis R, O'Connor P, Howe W, Bass S. Does gymnastics training inhibit growth of females? Clin J Sport Med 2001;11:260-70.
52. Lundin O. Ryggproblem vid elittträning i unga år. [Back problems in elite training at a young age.] Svensk Idrottsforskning 2007;1:51-3.
53. Strandell A, Bergendahl L, Kallings L. Sätt Sverige i rörelse 2001. Förskolan/skolan. [Get Sweden moving 2001. Preschool/school.] Report 2002;10. Stockholm: Swedish National Institute of Public Health; 2002.
54. NNR. Nordic Nutrition Recommendations. Integrating nutrition and physical activity. 4. edn. Report 2004:013. Copenhagen: Nordic Council; 2004.
55. American Alliance for Health PE, Recreation and Dance. Physical activity for children. A statement of guidelines. American Alliance for Health PE, Recreation and Dance (AAHPERD) Publications; 1998.
56. Cavill N, Biddle S, Sallis J. Health-enhancing physical activity for young people. Statement of the United Kingdom Expert Consensus Conference. Pediatric Exercise Science 2001;13:12-25.
57. WHO [World Health Organization] Annual global "Move for health" initiative. A concept paper. Geneva: World Health Organization; 2003.
58. Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, et al. Evidence based physical activity for school-age youth. The Journal of Pediatrics 2005;146:732-7.
59. Twisk JW. Physical activity guidelines for children and adolescents. A critical review. Sports Medicine (Auckland, NZ) 2001;31:617-27.
60. Dang P, Lundwall S, Engstrom L-M, Schantz P. Tiden talar för fysiskt aktiv skolpendling. [Time supports physically active school commuting.] Svensk Idrottsforskning 2006;3:14-5.
61. Giles-Corti B, Broomhall MH, Knuiman M, Collins C, Douglas K, Ng K, et al. Increasing walking. How important is distance to, attractiveness, and size of public open space? Am J Prev Med 2005;28(2 Suppl 2):169-76.
62. Hume C, Salmon J, Ball K. Associations of children's perceived neighborhood environments with walking and physical activity. Am J Health Promot 2007;21:201-7.
63. Fjortoft I. The natural environment as a playground for children. The impact of outdoor play activities in pre-primary school children. Early Childhood Education Journal 2000;29:111-7.
64. SBU (Swedish Council on Technology Assessment in Health Care). Metoder för att främja fysisk aktivitet. [Methods of promoting physical activity.] Stockholm: SBU; 2007.
65. Fjortoft I. Landscape as playscape. Learning effects from playing in natural environment on motor development in children. Dissertation. Oslo: Norwegian University of Sport and Physical Education; 2000.

66. Swedish Sports Confederation. Idrotten vill. [Sports want to.] Stockholm: Swedish Sports Confederation; 2005.
67. Ericsson I. Rör dig – lär dig. Motorik och inlärning. [Exercise - learn. Motor skills and learning.] Stockholm: SISU Idrottsböcker; 2005.
68. Thompson NS, Smolak L. Body image, eating disorders and obesity in youth. Assessment, prevention and treatment. Washington: American Psychological Association; 2001.
69. Sothern MS. Exercise as a modality in the treatment of childhood obesity. Pediatr Clin North Am 2001;48:995-1015.
70. Swedish Paediatric Society. Ansträngningsutlöst astma. Utredning och behandling [Exertion-triggered asthma. Examination and treatment.] ; 2006.
71. Stewart-Brown S. What is the evidence on school health promotion in improving health or preventing disease and, specifically, what is the effectiveness of the health promoting school approach? Copenhagen: WHO Regional Office for Europe's Health Evidence Network (HEN); 2006.
72. Swedish National Agency for Education. Läroplan för det obligatoriska skolväsendet, förskoleklassen och fritidshemmet Lpo 94. [Curriculum for compulsory schools, preschools and recreation centres Lpo 94.] 2006:23. Stockholm: Swedish National Agency for Education; 1994.