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Health related lifestyle habits of Swedish schoolchildren

Studies on knowledge, conception and behaviour

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There is no point in being grown up
if you can't be childish sometimes.

Dr Who

Contents

Abstract

Aim

The overall aim of this thesis was to evaluate the effects of the health education programme 'An adventure with Pelle Pump'. Further the aim was to provide knowledge of importance for the development of future programmes aiming to promote a healthy lifestyle in children by studying predictors for health behaviours, and the impact of time and age on health behaviours in Swedish schoolchildren.

Methods

To evaluate the impact of the health education programme 'An adventure with Pelle Pump' on knowledge and behaviour and determine what predictors were of importance for health behaviours, a 45 item questionnaire was answered by 1 422 12-year old children. To study conceptions of health and health behaviour in children, 16 children were face-to-face interviewed and the interviews were analysed using a phenomenographical method. To study the impact of time trends and age on health behaviours in Swedish school children results from the questionnaires were compared to results from the WHO-based 'Health Behaviour in School-Aged Children' studies.

Results

'An adventure with Pelle Pump' had a positive impact on knowledge and conceptions of health and health behaviours. However, two years after programme implementation it did not result in any change in health behaviours, i.e. physical activity, healthy food choices and refrain from tobacco, of these children.

Secular trends, from 1993 to 2003, had a positive influence on physical activity and sedentary behaviours, while negative time trends were observed in dietary habits and smoking. Increased age of two years had a statistically significant negative influence on physical activity, dietary habits and tobacco use.

To perceive your *family*, *yourself* or *someone else* as a source of inspiration to be physically active was related to a high physical activity level. Paternal and maternal attention to the use of tobacco was of importance for children to refrain such habit. To live in a socio economically wealthy area was of importance for healthy food choices and physical activity. Children from rural areas were more physically active than children from urban areas.

Conclusion

The evaluation of the impact of a knowledge-based health education programme with the intention to influence three important life style habits; physical activity, healthy food choices and refrain from tobacco, reveals that knowledge- based interventions implemented in school settings can improve knowledge and attitudes towards a healthy lifestyle. However, such programme, implemented as a sole effort does not influence health behaviours.

Importantly, this thesis demonstrated that the window of opportunity for promoting health behaviours in children is narrow and, to be successful, interventions need to be implemented at an early age and repeated over time. Interventions to promote a healthy lifestyle may target children within the school setting, but parents need to be involved since parental support is of utmost importance for children to make healthy life choices.

Interventions should, with support from the present findings, not be limited to knowledge-based education but include a substantial proportion of practical, behaviour focused actions.

Sammanfattning

Syfte
Det övergripande syftet med denna avhandling var att utvärdera den kunskapsbaserade hälsointerventionen ’På äventyr med Pelle Pump’. Vidare var syftet att bidra med kunskap av vikt för genomförandet av nya hälsointerventioner genom att studera prediktorer för hälsobeteenden, samt hur tid och ålder påverkar hälsobeteenden hos svenska skolbarn.

Metoder
För att utvärdera ’På äventyr med Pelle Pump’ avseende kunskap och hälsobeteenden samt studera faktorer av vikt för hälsobeteenden, besvarade 1 422 12 åriga skolbarn en enkät bestående av 45 frågor. För att beskriva inställning till hälsa och hälsobeteenden deltog 16 andra barn i samma ålder i djupintervjuer som sedan analyserades med hjälp av fenomenografisk metod. För att studera hur tid och ålder påverkar hälsobeteenden hos skolbarn jämfördes resultaten från enkätstudien med resultat från den WHO-baserade studien om svenska skolbarns hälsovanor.

Resultat
’På äventyr med Pelle Pump’ hade en positiv inverkan på barnens kunskaper om och inställning till hälsa och hälsobeteende. Programmet resulterade däremot inte, två år efter interventionens genomförande, i några beteendeförändringar avseende fysisk aktivitet, kostvanor och rökning.

Förändringar över tid, från 1993 till 2003, hade en positiv inverkan på svenska skolbarns fysiska aktivitet som ökade parallellt med en minskning av faktorer relaterande till inaktivitet. Kostvanorna påverkades i negativ riktning liksom förhållningen till tobaksbruk. En ökning i ålder med två år medförde signifikanta försämringar avseende fysisk aktivitet, kostvanor och rökning.

Att uppfatta *sin familj*, *sig själv* eller *någon annan* som en inspiration till att vara fysiskt aktiv relaterade till en hög fysisk aktivitetsnivå. Att uppleva ett starkt föräldraengagemang mot tobaksbruk var av betydelse för att avstå från att prova på att röka. Att bo i ett socioekonomiskt välbärgat område hade stor inverkan på barnens fysiska aktivitetsnivå och kostvanor. Barn från landsbygden var mer fysiskt aktiva än de som bodde i storstaden.

Konklusion
Utvärderingen av betydelsen av den kunskapsbaserade hälsointerventionen ’På äventyr med Pelle Pump’ med syftet att påverka kunskap, attityder och tre viktiga hälsobeteenden; fysisk aktivitet, kostvanor och rökning, visar att kunskapsbaserade interventioner genomförda i en skolmiljö har förutsättningar att påverka kunskapsnivåer och attityder till hälsa. Däremot förefaller en sådan kampanj, som isolerad företeelse, inte påverka barns hälsobeteenden.

Värt att poängtera är att denna avhandling talar för att det tillgängliga tidsfönstret för att påverka barns hälsobeteende är begränsat och att interventioner därmed bör initieras tidigt i åldrarna och upprepas över tid för att optimera förutsättningarna för framgång. Interventioner med syftet att påverka barns hälsobeteenden kan genomföras i en skolmiljö, dock måste föräldrar och övrig familj involveras i sådana program, då föräldrastöd är av stor vikt för att barn ska göra hälsosamma livsstilsval. Interventioner bör, mot bakrund av de aktuella resultaten, inte begränsas till kunskapsförmedling utan även innehålla ett betydande mått av praktiska, beteendeinriktade åtgärder.

List of original publications

This thesis is based on the following original studies, which will be referred to by their Roman numerals.

I
Lindberg LC, Ståhle A, Rydén L.
Long term influence of a health education programme on knowledge and health behaviour in children.
European Journal of Cardiovascular Prevention and Rehabilitation 2006;13:91-7.

II
Lindberg LC, Rydén L, Ståhle A.
Conceptions of health behaviour in Swedish preteens.
In manuscript

III
Lindberg LC, Rydén L, Öhrvik J, Ståhle A.
Impact of time and age on health behaviour in Swedish schoolchildren.
European Journal of Cardiovascular Prevention and Rehabilitation 2006; in press

IV
Lindberg LC, Rydén L, Ståhle A.
Predictors of healthy behaviours in Swedish schoolchildren.
European Journal of Cardiovascular Prevention and Rehabilitation 2006; in press

Introduction

Unfavourable lifestyle changes accompanying industrialisation, urbanisation, and increased discretionary income increases the degree of exposure to cardiovascular disease risk factors [1]. An early introduction of a healthy lifestyle as healthy food habits, regular physical activity and refrain from the use of tobacco, is essential in the prevention of cardiovascular disease and several other chronic diseases [2, 3], since health behaviours track from childhood to adulthood [4]. A reason to target intervention strategies in children is that their behaviours may be influenced more easily than already established unfavourable habits among adults. In addition, cardiovascular disease has its onset already at an early age and disease processes may be more effectively altered at relatively young ages [5].

The growing concern of overweight may be taken as an example of the importance to start counteracting unhealthy habits and their outcome early in life. The prevalence and severity of overweight is increasing in children and adolescents. In many developed economies child obesity levels have doubled during the last two decades [6], and are set to double again probably over an even shorter time period [7]. Obesity present in adolescence is associated with an increased overall mortality and, specifically with an increased risk of cardiovascular disease and diabetes in adult men and women [8-10]. Furthermore, adolescence has been identified as a period in life when overweight and obesity frequently is developed [11]. Preventive strategies should, therefore, consider implementation already prior to the onset of this critical period for founding future obesity. When implementing interventions to promote health and prevent diseases emphasis should be on helping children develop the knowledge, attitudes and behavioural skills they need to establish a healthy lifestyle throughout life [12, 13].

Health related lifestyle habits in children

Physical activity and inactivity

Physical activity is defined as any bodily movement produced by skeletal muscles that result in energy expenditure. Exercise is defined as a subset of physical activity that is planned, structured, repetitive, and purposeful in the sense that improvement or

maintenance of physical fitness is the object. Physical fitness includes cardio-respiratory fitness, muscle strength, body composition, and flexibility, composing a set of attributes that people have or achieve and that relates to the ability to perform physical activity. [14, 15]

Although cardiovascular disease usually does not become evident until middle-age and beyond, the development of the disease begins in childhood and adolescence [16, 17]. Moreover, risk factors for cardiovascular disease track from childhood into adulthood [9, 18]. High physical fitness during adolescence and young adulthood is related to a healthy cardiovascular disease profile later in life [19]. Although there is no direct proof that physical activity in childhood protects from cardiovascular disease in adulthood, physical inactivity and low physical fitness are independent risk factors for cardiovascular disease and all-cause mortality in adults [20, 21]. Accordingly, it seems rather unlikely that physical activity habits, founded at young age, would not provide some benefit in future life, in particular since physical activity and inactivity seem to be inherited from child- to adulthood [22-24]. If this assumption is true, it is essential that children, at an early age, are introduced to and become interested in physical activity in order to create a positive attitude towards an active lifestyle throughout the lifespan. Promoting physical activity in the young population as a public health initiative is built around four suppositions: 1) the child might receive immediate health and social benefits; 2) intervention at critical periods in physical growth and maturation in childhood may enhance adult health; 3) modifying chronic disease risk factors in childhood might lower disease rates and risk factors in the adult years; 4) modifying behavioural preferences or practices in childhood might lead to altered behaviours in adulthood that would offer protection from chronic disease at that time [25-27]. Based on these suppositions, the recommendation for physical activity in young people is to participate in physical activity of at least moderate intensity at a minimum of one hour accumulated physical activity per day [28].

Many young people participate in regular physical activities and sports and are enjoying the benefits of pleasure, friendships and health. However, large numbers of young people are not taking part in physical activity to the level recommended to benefit their health [29-32]. The provision of physical education in schools has declined in many countries. Outside school, opportunities to be physically active in daily life are decreasing due to a combination of a limited availability of safe and accessible places for physical activity, lack of adult support, supervision and guidance and an increasing popularity of the car as a mode of transportation. Despite this, children are more involved in structured activities, as organized sport and exercise, than 20 years ago. This shift in physical activities indicates that unstructured activities in daily life, as transportation by foot or bike and playing, have decreased [33]. In Sweden it is estimated that at least 30 percent of adolescents do not achieve appropriate levels of physical activity [34]. Another reason why children are less physically active may be the increasing use of computers or television as a mode of recreation [35].

Food habits

The adoption and maintenance of a balanced nutrition is essential for a healthy life [36]. Eating patterns of children and adolescents have changed considerably over time. Not the least the increasing exposures to free carbohydrates, contributing to excess calorie intake,

have become more common. Diets too rich in fat and too low in fruit and vegetable content is another concern [37, 38]. The amount of saturated fat is the major determinant of serum cholesterol level, which in turn is one of the most important cardiovascular risk factor in industrialized countries [39]. The agricultural policy has promoted a practically unlimited production of fatty milk products and low-quality fatty meat, which has been marketed to the consumers at a subsidized price. One striking example is the School Milk Measure, which by fiscal means intends to stimulate the consumption of whole milk and cheese among school children. National statistics showed that the vast majority of schools and day-care centres in Sweden took advantage of the subsidies [40]. In this way the School Milk Measure may contribute to the problem of childhood obesity and future cardiovascular disease, and low-fat diary products should therefore be subsidised instead of fatty milk products [40].

Breakfast consumption is a predictor for the whole-diet nutrient adequacy [41] and skipping breakfast is a common behaviour in overweight or obese children [42]. It is, therefore, important that children and adolescents consume an adequately composed breakfast, at home or at school, on a daily basis [42].

Another key factor for the preservation of health is a sufficiently high consumption of fruit and vegetables [20]. However, the price level of fruits and vegetables is maintained in the European Union (EU) by withdrawing a substantial part of the crops from the market. Amazingly EU is the world's largest importer of fruit and vegetables, and the second largest exporter [40]. Hence, while evidence for health benefits of increased consumption of fruit and vegetables grow [20, 43], nutritional surveys reveal that children are not meeting the recommended minimum consumption suggested to be at least 400 g/day [44, 45]. In addition, fruit and vegetables may play a role in improving the overall nutritional pattern by replacing or decreasing less favourable food elements, and may thus be seen as indicators of healthy food [43]. In Sweden, a free school lunch consisting of a warm meal, salad, bread and milk or water is offered every school day to all children. School lunch has been regarded as an important contributor to fruit and vegetable consumption among elementary school students [46] as school lunch can promote the consumption of vegetables among those who rarely consume vegetables at home [47].

Tobacco use

Tobacco use multiplies the risk for a great number of diseases [48], and tobacco use was one of the first identified risk factors to be linked to cardiovascular diseases [9]. Thus, an important public health objective is to convince children to abstain from smoking [49]. The initiation of smoking prior to teenage years is clearly associated with regular smoking later in life [50]. Smoking during adolescence has been identified as a risk factor for the development of nicotine dependence in adulthood [51]. Of those who start smoking in their teenage years, and keep on smoking steadily, about half will eventually die from tobacco induced diseases, about one quarter in old age and one quarter already in middle age [52]. In a Swedish study it was underlined that boys start to experiment with tobacco earlier and establish smoking habits at a younger age than girls. Although girls start to smoke somewhat later, they easily reach the level of boys and even pass them. It has been reported that as high proportion as 19 percent of 11 year old children had regular smoking habits [53].

Primary disease prevention programmes in childhood

Initiatives aimed at promoting health and preventing disease varies in scope, from measures targeting individuals or small well-defined groups to interventions targeting a whole population. Similarly, interventions can be implemented at different levels ranging from programmes directly influencing individual behaviour to more indirect interventions e.g. legislation, taxation, labelling or other health policy initiatives. The majority of interventions related to children and adolescents have been targeted at the school or family level, but there is increasing recognition that reaching the community at all levels is important for interventions to be effective [54].

School based interventions

Public prevention have been proposed to begin with schools and extend to the entire community [55]. School staff have access to large numbers of children in a learning environment that has the potential to support healthy behaviour and is favourable for the delivery of health promotion programmes [56]. In principle, schools can provide an excellent setting for preventing obesity and promoting health behaviour. Almost all children in developed countries are in school for a considerable period of time, children from all risk groups can derive some benefit, and targeting all children avoids stigmatizing and misclassifying individuals.

Three major components within schools have a potential to contribute to the prevention of lifestyle related diseases: the physical education programme, classroom health education and the school food service [57]. Moreover, schools offer regular contact with children during term-time providing ample opportunities to influence nutrition, provide education and to promote physical activity. This may not only be accomplished within the formal curriculum, but also informally via the provision of appropriate facilities within the school environment. Among those healthy school meals, break-time snack provision and playground equipment seem to be of particular importance [58, 59]. Thus, schools do not only influence knowledge and attitudes of children. They also provide opportunities for experiential learning and the development of self-efficacy. Importantly, the school should also provide links with the family and the wider community in their attempts to foster a healthy living [6].

The school has, therefore, been an obvious environment for programmes aimed at health promotion. There are evidence that theory-based interventions, including classroom curricula, physical education curricula, changes in school meals, vending machines, cafeterias and after school programmes can increase physical activity and improve dietary patterns in children and adolescents [60]. School-based prevention programmes involving both healthy food choices and physical activity have been reported more successful than those only addressing food or physical activity as separate entities [60]. Studies on school based interventions to increase physical activity and healthy food choices are listed in Table 1 [57, 61-64].

As can be seen in Table 1, the outcomes of school-based prevention interventions are inconsistent. Still some conclusions may be drawn. To be successful school-

Table 1. Descriptions of three school-based prevention interventions

First author [reference], year, country	Study design	Intervention method	Follow-up period	No of children/ age	Results
Gortmaker SL [65], 1999, USA	RCT	Classroom health curricula to ↓ TV viewing ↓consumption of high fat foods ↑ fruit + vegetable consumption ↑ moderate and vigorous PA	18 months	1295 (I=641; C=654) Mean age 11.7	↓obesity, girls ↓ TV viewing, boys and girls ↑ fruit + vegetable consumption, girls ↓consumption of high fat foods, girls → physical activity
Howard JK [66] 1996, USA	RCT	Lifestyle education, diet, physical exercise, antismoking	Intervention 1 month Follow up 1 year	83 9-12 years	↑ physiology knowledge ↑ physical exercise → BMI
Sahota P [67], 2001, UK	RCT	Lifestyle education consisting of teacher training, school meal modification, promotion of physical activity	1 year	636 (I=314; C=322) Mean age 8.4±0.6	↑ knowledge ↑ vegetable consumption → weight → physical activity → sedentary behaviour

RCT = Randomized Controlled Trial, CCT = Controlled Clinical Trial, I = Intervention group, C = Control group, ↓ = significant decrease, ↑ = significant increase, → = non significant difference

based interventions should be multi-faceted, combining a classroom programme with environmental changes in the school (cafeterias, physical education classes, class time, lunch or recess). Home or community interventions should be behaviourally focused, as general programmes have been shown to be effective for knowledge gains only.

Family-based interventions

The development of family based prevention programmes for childhood overweight has been considered a primary public health goal [6]. There is increasing recognition of the importance of family and community level interventions, particularly as the majority of young people's activity occurs outside of school hours. Family level interventions are thus viewed as important because of the influence of family environment [68]. Family-based interventions involve the family with the primary aim to change the behaviour of the entire family. The involvement of the whole family in the prevention programme is important not only because family members share behaviour and concomitant risk but also because it is hard to attempt to intervene with the child if family members do not concurrently support the intervention and when needed also modify their own behaviour [69, 70].

As can be seen in Table 2, most studies in this area have addressed children who already are obese together with their parents [71], and the effectiveness of family level interventions is generally poor for healthy populations [72]. Where family level interventions have

been included within multi-level interventions, the specific effect of the family based intervention has been limited as exemplified in the study by Nader et al. [73] in Table 2.

In this context, family therapy is effective in preventing the progression of severe obesity [74]. Most of the family-based intervention studies have resulted in positive long-term changes in health related behaviours in obese children and adolescents [71].

Combining school-based and family-based interventions

Families provide the microenvironments within which children learn and enact healthy behaviours. However, parental efforts to provide an environment that will promote a normal body weight are likely to be undermined by the broader environment in which they function, if interventions target families alone [75]. Thus, there are strong

Table 2. Descriptions of three family-based prevention interventions

First author [reference], year, country	Study design	Intervention method	Follow-up period	No of children/ age	Results
Nader PR [73]1996, USA	RCT	Three groups of children: 1. School-only intervention 2. School + family intervention 3. Control group Education on nutrition and physical activity. Changed diet with low fat and salt content. Increased physical activity	Intervention 1 year Follow up 3 years	1 711 children in the school+ family programme 11-12 years	When compared to the school only programme; → BMI ↑ knowledge ↑ attitudes → behaviour
Epstein LH [76], 1995, USA	RCT	Three groups of obese children: 1. ↑ physical activity (PA) 2. ↓ sedentary behaviour (SB) 3. ↑ physical activity + ↓ sedentary behaviour (PASB)	Intervention 4 months Follow up 1 year	55 families Mean age 10.1	↓ % body fat (PA vs SB and PASB vs SB) ↑ preference for high-intensity activities (PA vs SB) ↑ energy intake (PA vs SB and PASB)
Flodmark CE [74], 1993, Sweden	CCT	Three groups of obese children: 1. dietary counselling (DC) 2. dietary counselling + family therapy (FT) 3. Controls (C)	Intervention 14-18 months Follow up 1 year	94 10-11 years	↓ BMI (FT vs DC and C) ↓ Skinfold thickness (FT vs DC) ↑ Physical fitness (FT vs DC)

RCT = Randomized Controlled Trial, CCT = Controlled Clinical Trial, I = Intervention group, C = Control group, ↓ = significant decrease, ↑ = significant increase, → = non significant difference

theoretical reasons for including a family component in a school-based health promotion intervention, especially when dealing with eating, physical activity and the use of tobacco [77-79], since the family provides a major source of influence and modelling of health behaviours. Whether the selected intervention approach is school or community-based the importance of good relations between the school, the family and the community must be emphasized [80]. Moreover comprehensive approaches which integrate intervention programmes with family and community efforts are more successful in promoting health and in preventing unfavourable habits than are programmes in which the schools try to do it alone [69, 70].

Family based interventions may enhance school intervention and combined they may be even more successful [81]. In Table 3 some of the most frequently cited studies on the combination of school- and family-based interventions are described.

'An adventure with Pelle Pump'

In the 1990s, the British Heart Foundation constructed a study kit on cardiovascular function intended for seven to nine year old children [82]. This material was further developed by the Swedish Heart and Lung Foundation in the health education programme 'An adventure with Pelle Pump' (APP) [83]. This school-based prevention programme

Table 3. Descriptions of three different school- and family-based prevention interventions

First author [reference], year, country	Study design	Intervention method	Follow-up period	No of children/ age	Results
Caballero B [84] 2003, USA	RCT	Changed diet. Increased physical activity. Health education. Family involvement.	3 years	1409 Mean age 7.6±0.6	↑ knowledge of health behaviour ↓ high fat foods ↑ physical activity → % body fat
Robinson TN [85], 1999, USA	RCT	Classroom curriculum to reduce television, videotape and video game use. Motivation for parents to help their children watch less TV.	Intervention 6 months	192 Mean age 8.9	↓ BMI, waist + hip circumference, skinfold thickness ↓ TV viewing → dietary variables → physical activity
Sallis JF [86], 2003, USA	RCT	↑ total energy expenditure from physical activity ↓ total and saturated dietary fat purchased at or brought to school by students. Parental and community intervention	2 years	1484 11-14 years	↑ overall physical activity, boys ↑ PE physical activity ↓ BMI, boys → dietary variables

RCT = Randomized Controlled Trial, CCT = Controlled Clinical Trial, I = Intervention group, C = Control group, ↓ = significant decrease, ↑ = significant increase, → = non significant difference

was directed towards ten year old school children, with the primary intention to increase knowledge on health and health behaviours and support positive attitudes towards health and, secondarily, to support the development of healthy behaviours. Sections on respiratory function, smoking, nutrition and physical activity were added to the manual for the teachers as well as in the booklets, including theoretical and practical material for the children. The study kit was, free of charge, offered to all 4th graders in Swedish community schools. Teachers were free to use the study material, to teach children about bodily functions and the consequences of healthy and unhealthy behaviour, in any way they preferred. Timetabling within schools varied from four classes per week to one during the programme period of three months.

Since initiation in the year 2000, more than 400 000 ten year old children have participated in 'An adventure with Pelle Pump'. The main components of the Swedish Heart and Lung Foundation's promotion of this programme were the development and distribution of the material and some education seminars to inspire the teachers.

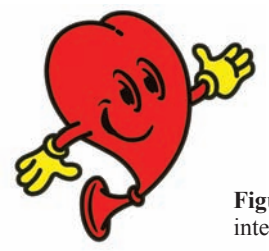

Figure 1. Pelle Pump, the little heart figure guiding children through the intervention programme 'An adventure with Pelle Pump'.

Assessments of health related lifestyle habits in children

When considering the impact of an intervention it is necessary to first decide the outcome variable based upon which ratings of effectiveness will be assessed. Programmes intended to improve healthy habits may be evaluated in several perspectives and among them their ability to induce lasting effects in physiological, cognitive, affective or behavioural terms respectively. Arguably changes at all these levels are important. It has been underlined that because health benefits of behaviours in youth are transitory it is mandatory to establish behaviour patterns that can be carried into adulthood. Thus effectiveness should preferably be based on both short- and long-term behavioural changes [54, 72].

Assessing the effectiveness of an implemented programme by assessing physical activity levels, food habits and tobacco use of school aged children is important for future research and intervention efforts. However, presently several assessment methods of different feasibility, validity and reliability are used and need to be understood in order to provide evidence on childhood health related behaviours.

Physical activity and inactivity

Techniques used to assess physical activity among children and adolescents can be divided into three types of measures: primary, secondary and subjective measures.

Primary measurements, as doubly labelled water and indirect calorimetry, offers the greatest precision when it comes to measuring physical activity and energy expenditure, but are costly and difficult to implement [87]. This limits their applicability in large, population based studies [88].

Secondary measurements, like heart-rate monitoring (where physical activity is estimated based on the assumption of a linear relationship between heart rate and oxygen uptake (VO_2) [89]) pedometers (designed to estimate mileage walked and/or steps taken over a period of time [90],) and accelerometers (which specifically measure accelerations produced by body movements [91]), provide an objective, non-reactive and re-usable tool for assessing physical activity. Still, accelerometers and pedometers have a limited ability to access physical activities and sports cycling and swimming [90].

Subjective measures include a variety of approaches for example activity diaries, proxy reports and self-administered or interviewer based questionnaires. Self-report measures offer a relatively inexpensive way to assess physical activity levels in large numbers of individuals, while maintaining low investigator and respondent burden. This is the obvious reason why such reporting is the most common method of estimating physical activity [88, 92]. Their greatest limitation is the inherent subjectivity. The issues of recall errors, deliberate misrepresentations, social desirability and other biases are particularly important when dealing with children [90, 92].

Food habits

Methods commonly used to assess the food habits of children include investigator-based techniques, such as direct observation and collection of duplicate portions, and physiologic measures. The following five, respondent based, methods are traditionally used in epidemiological studies: direct observations, diet history, food records, 24-h recall and food frequency questionnaires [93].

Direct observations or in-home weighed food records are the only methods for assessment of food habits that ascertain the quantitative and qualitative validity of all nutrients consumed. Both are usually too expensive for epidemiological studies of diet and disease [93].

Diet history assesses usual meal patterns, food intake and food preparation practices through an extensive interview or questionnaire [93, 94]. This method provides a measure of the ordinary food intake and is considered appropriate for ranking individuals and predicting health outcomes [95].

The 24-h recall is an estimate of the actual intake based on a detailed description obtained by a structured interview of a child and/or adult caregiver by a trained nutritionist or other professional. It lists everything the child ate or drank during a specified time period, typically the previous day [94].

Food records are written accounts of the actual intake of food and beverages consumed during a specified time period, usually three to seven days [93, 94]. A single food record is a measure of actual intake and is, as the 24-hour recall, adequate for estimating group means but not as a tool to predict health outcomes on the individual level [95].

Food frequency questionnaires aim for a representative picture of food habits in order to get a better predictor of chronic disease than consumption during a single day only [96].

As they are easily administered and inexpensive, food frequency questionnaires are often used in epidemiological studies and are useful for predicting health outcomes at both a group and an individual level [95].

Tobacco use

Techniques commonly used to assess the smoking habits of children include naturalistic observations, biomarker analysis and self-reports [97].

Naturalistic observation consists of observing behaviour as and where it occurs naturally. Such observation might include monitoring and or surveying subjects, and might also involve the analysis of the remains of tobacco products. The simplest and least invasive form of naturalistic observation involves detailed monitoring of adolescent tobacco use behaviour from a distance [98].

Biomarker is a measurement that reflects the interaction between a biological system and a chemical, physical, or biological environmental agent [99]. Regarding tobacco smoke, the biomarker may be used to identify the exposure to or consumption of tobacco either by direct or indirect means. Common biomarkers used to measure tobacco smoke consumption is carbon monoxide (CO), nicotine, cotinine and thiocyanate [97].

Self-report is the technically easiest and least expensive measurement strategy. The participants are asked to respond to questions, either verbally or in writing, regarding smoking abstinence or cigarette consumption. The primary advantages of self-report are: ease of use, feasibility and low cost [97]. Adolescents have been found to be more likely than the general population to deny smoking [100]. They may on the other hand inflate their report of cigarette use in an attempt to appear rebellious and receive peer attention [100].

Overweight and obesity in children

The primary purpose for defining overweight and obesity are to predict health risks and to provide comparisons between populations [6]. The definition of childhood obesity remains problematic. Quick, simple and relatively inexpensive techniques for the estimation of body fat in children are skin fold thickness, [101] and bioelectric impedance assay. Another technique is to use anthropometric data such as waist circumference [102], which in adults is advocated to be used as indices of abdominal visceral adipose tissue deposition and in the assessment of cardiovascular risk [103]. In children, however, waist circumference currently lacks cut-off values for defining high or low health risks [6, 104].

There are many definitions of childhood overweight and obesity involving a measure of body fat, usually Body Mass Index (BMI), and a reference centile chart where centiles define cut offs for overweight and obesity [105]. Body mass index is useful for depicting overweight at a population level, although it represents an imperfect approximation of excess adiposity [6]. Body mass index in childhood changes substantially with age [106], which in itself makes BMI definitions of overweight and obesity for children more complex than those for adults, in whom a single cut off value can be used for all ages.
The international Obesity Taskforce (IOTF) set of reference values [107], are based on data from six international BMI references and utilises centile cut offs to ensure that they match adult cut offs of 25 and 30 kg/m^2 at the age of 18 (Table 4) [105, 107].

Table 4. International cut off points for BMI for overweight and obesity by sex between 10 and 18 year, defined to pass trough BMI of 25 and 30 kg/m^2 [107].

	Body mass index 25 kg/m^2		Body mass index 30 kg/m^2	
Age (years)	**Boys**	**Girls**	**Boys**	**Girls**
10	19.84	19.86	24.00	24.11
11	20.55	20.74	25.10	25.42
12	21.22	21.68	26.02	26.67
13	21.91	22.58	26.84	27.76
14	22.62	23.34	27.63	28.57
15	23.29	23.94	28.30	29.11
16	23.90	24.37	28.88	29.43
17	24.46	24.70	29.41	29.69
18	25	25	30	30

Thus, BMI definitions of childhood overweight are useful for tracking prevalence and trend data and are recommended to be used as main measure for survey purposes [6], but these should not be confused with clinical diagnoses or functional definitions.

Rationale for this thesis

Measurement of programme effectiveness, implementation and policy adoption is an essential component of any public health or educational intervention in order to ensure the success of such programmes. Since the early 1990's numerous school-based dietary and physical activity promotion programmes have been developed and implemented across the world. A large number of potentially useful interventions have been conducted, however, without proper evaluation as regards efficacy and long-lasting results. Funding agencies should therefore realise that their investments are being squandered if the products of their funding are not assessed and, if successful, used by others [7]. The evaluation of intervention programmes, as well as research on which groups of children are at specific risk for future diseases or ill health and therefore in need of prevention strategies, is of utmost importance in order to acknowledge programmes worth investments in time and money.
It should be mandatory to evaluate long term changes in behaviour, knowledge and attitudes as a result of health intervention programmes and then use both quantitative and qualitative measures when evaluating the outcome. Even though several programmes have been implemented and evaluated, many evaluations have not measured long term effects of the studied intervention.

Studies of secular trends in physical activity, food choices and tobacco use can help identify the influences of social and lifestyle changes. More specifically, the results from the evaluation of the curriculum-based health intervention 'An adventure with Pelle Pump' two years after implementation, and information on the predictors for health behaviours of children, may provide useful information to tailor future prevention programmes for contemporary children and adolescents.

Aims

The overall aim of this thesis was to evaluate the effects of the health education programme 'An adventure with Pelle Pump' and provide knowledge of importance for the development of future programmes aiming to promote a healthy lifestyle in children.

The specific aims in the four studies were as follows;

Study I
To evaluate the impact of the Swedish health education programme 'An adventure with Pelle Pump' on health knowledge and health behaviour among programme participants using non-participants as a control population two years after they had participated or not in the programme.

Study II
To describe conceptions of health and health behaviour among 12-year old children and to examine whether these conceptions were influenced by participation in the Swedish health education programme 'An adventure with Pelle Pump'.

Study III
To assess the importance of age and time trends on health behaviour among Swedish school children by comparing the outcome of 'An adventure with Pelle Pump' evaluation with previous WHO-based 'Health Behaviour in School-Aged Children' surveys.

Study IV
To evaluate the impact of three domains: intrapersonal, social and environmental, on predictors for adopting a healthy lifestyle in Swedish schoolchildren.

Materials and methods

Studies I, III and IV

Study population

In May 2003, 2 084 schoolchildren from 86 sixth grade classes in 78 schools were invited to participate in the present investigation via a random sample of 86 teachers selected from the Swedish school record. After stratification, as regards campaign participation (yes or no), socioeconomic area (very affluent + affluent, average affluent + average, average neglected + neglected or poor + very poor) [108] and geographical area (urban or rural), questionnaires were distributed to the teachers with a letter explaining the nature of the project. The teachers were asked to let the children answer the questionnaires during an ordinary lesson without influencing them with any instructions besides those given in the letter. Children who had previously participated in 'An adventure with Pelle Pump' comprised the programme group and those without previous participation served as the control group.

The questionnaire

Studies I, III and IV were based on a questionnaire including questions reflecting knowledge on bodily functions and health behaviour and actual health behaviours as physical activity, food habits and refraining from tobacco. The questions on knowledge were constructed for the specific purpose of this study relating directly to the material used in 'An adventure with Pelle Pump'. In order to facilitate comparison with other study populations and the impact of time trends questions on health habits were derived from one national and one international questionnaire [29, 109].

The validity of the questionnaire was secured in two steps. It was first tested in a pilot population of 45 10-year-old children from schools with similar backgrounds as schools included in the study. Second, two nine year old girls were asked to describe their interpretation of the questions. The children participating in the validation process were intentionally selected to be somewhat younger than the study population to secure the understanding of the questions. Some questions were rephrased after the validation process to ensure correct interpretation.

The final questionnaire comprised 45 items. Sixteen of them related to knowledge on bodily function and health behaviour and 29 to health behaviour: physical activity (n=9); food habits (n=5); smoking (n=9) and moist snuffing (n=6). In addition self-reported information on height and weight were derived from the children for the calculation of body mass index (BMI).

Definitions

Body Mass Index (BMI) was calculated by dividing weight in kilograms by squared height in meters. Overweight in adults is defined as a BMI of 25–30 kg/m^2, and obesity as greater than 30 kg/m^2. In youth, BMI values are, according to Cole et al. [107], defined as cut-off points, which passes through 25 and 30 kg/m^2 at the age of 18 years. In the analyses presented in this study this recommendation was followed according to Table 4.

Socio economical living area was categorized into the following four categories; S1 = very affluent + affluent, S2 = average affluent + average, S3 = average neglected + neglected, S4 = poor + very poor [108].

Rural living area was in this thesis defined as a community with < 30 000 inhabitants. The included communities ranged from 7 100 to 29 800 inhabitants, with a mean of 14 017.

Study protocols

Study I

In study I, the impact of the health education programme 'An adventure with Pelle Pump' on health knowledge and health behaviours was evaluated.

Knowledge scores

Knowledge was expressed as scores in which each correctly answered question scored 1 point, whereas incorrect, uncertain (i.e. two answers to one question) or missing responses scored 0. The level of knowledge was defined as the number of correct answers to questions related to a specific issue. Differences in the level of knowledge were expressed in two dimensions. Each of them was covered by eight questions, those related to knowledge on health behaviour and those related to knowledge on bodily functions/physiology, respectively. Difference in the level of knowledge was subsequently assessed from each subgroup of questions and from the total sum of questions.

Behaviour indices

To facilitate comparisons of health behaviour between the two groups, indices were derived for physical activity, nutrition and refraining from tobacco. Each question included response alternatives varying from healthy (score 4) to unhealthy (score 1). Each index was derived by multiplying the score from each question with a weight factor, relating to time and importance to health, for that particular question, with the implication that a high index value reflected a healthy behaviour (Table 5).

Table 5. Pertinent questions chosen for each behaviour index with accompanying weight and maximum score.

Question	Weight	Max score
Physical activity index (5 questions)		
Are you physically active during weekdays?	1	4
Are you physically active during weekends and school holidays?	1	4
How often do you exercise so that you become sweaty?	1	4
About how many hours a day do you usually watch TV (incl. videos)?	5/7	2.9
a. On weekdays?	2/7	1.1
b. On weekends?		
About how many hours a day do you usually use a computer (for e-mail, games, internet etc.)?		
a. On weekdays?	5/7	2.9
b. On weekends?	2/7	1.1
Nutrition index (5 questions)		
How often do you usually have breakfast on weekdays?	1	4
How often do you usually have breakfast on weekends and school holidays?	1	4
How many times a week do you usually eat…		
a. …fruit?	1/2	2
b. …vegetables?	1/2	2
How many times a week do you usually eat or drink…		
a. …sweets (candy or chocolate)?	1/2	2
b. …soft drink (ex. Coca cola)?	1/2	2
When you eat lunch or dinner, what proportion vegetables do you usually have? Including fruit for dessert.	1	4
Tobacco use index (3 questions)		
How many of your friends smoke cigarettes?	1	4
How many adults in your proximity do you think smoke cigarettes?	1	4
How often do you smoke?	1	4

Study III

In Study III, health behaviours of the children included in Study I were compared to those from the WHO-based 'Health Behaviour in School-Aged Children' (HBSC) studies in order to describe the impact of age and time trends on health behaviours.

The 'Health Behaviours in School-Aged Children' cohorts

The WHO based 'Health Behaviours in School-Aged Children' (HBSC) studies were performed in November/December 1993, 1997 and 2001 [29], targeted at children in the

5th and 7th grade (mean age = 11.5, 13.5). Inclusion was performed according to a two step cluster design. Firstly, schools were chosen to be representative for Swedish children. Secondly, all selected schools comprised the cluster and one class from each school was randomly selected for the purpose of the investigation.

The compared questions

Sixteen of the questions on health behaviours used in the 'An adventure with Pelle Pump' questionnaire were the same as those used in the HBSC studies [29]. The HBSC questionnaire consisted of 80 items in 1993, 83 in 1997 and 74 in 2001. The structure of the compared questions was as follows:

Physical activity: following a definition and examples of common physical activity (i.e. any activity that increases your heart rate and makes you get out of breath some of the time), the children were asked how many days a week they were physically active (cumulative activity including sports, school activities, playing with friends, and walking to school) for 60 minutes or more.

Sedentary behaviours: how many hours they watched television (including video or DVD films) and used a computer (for playing games, e-mailing, chatting, or Internet surfing) in their free time during a typical weekday and weekend. The possible responses were none, less than 1 hour, about 1-3, 4-6 or ≥ 6 hours per day.

Dietary variables: how many times during a typical week they had breakfast and how often they consumed fruits, vegetables, soft drinks and candy/sweets. The possible responses were never, less than once a week, 1-2 days a week, 3–4 days a week, 5–6 days a week, once a day, and more than once a day.

Smoking: if they had ever tried smoking and, in case of a positive reply, how often they smoked.

Study IV

In Study IV predictors for health behaviours in school children were analysed. An ecological model was used for the correlates of the studied domains of predictors (intrapersonal, social and environmental), [110]. This model was applied on all three studied behaviours; physical activity, nutrition and tobacco use.

The intrapersonal domain

This domain included gender, age and BMI.

The social domain

This domain contained sources of inspiration (multiple answers were possible) for the children to be physically active and the children's perception of their parent's level of attention to their smoking. The following sources of inspiration for physical activity were possible answers: *family*, *coach*, *physical education-teacher*, *media*, *yourself*, or *someone else* (i.e. a dog, idol or someone else than those previously mentioned). The

children graded their perception of the parental level (paternal and maternal separately) of attention to smoking on a four-graded scale, from 'pays no attention at all' to 'pays great attention'.

The environmental domain

This domain was based on socio economical living area and living in a rural or urban area.

Study II

Study population

A total of 36 12-year old children in the sixth grade were approached through their teacher, who served as a gatekeeper in this selection.

In order to avoid a selection bias, the teacher was asked to choose girl number four and boy number four from the alphabetic list of the children in the respective class. These children and their parents were given written information about the study. The parents were then asked to give their written informed consent to study participation, thereafter the children were contacted by telephone by one of the researchers (LCL).

The interviews

In Study II children were interviewed on their conceptions of health and health behaviour. These interviews took place in separate rooms in the children's schools between May and October 2003. The children were interviewed by one of the authors (LCL).

An interview guide (Figure 2) consisting of ten questions was used. These questions were followed up by open-ended probing questions to encourage the children to speak about experiences and thoughts from their own life.

The objective was to capture children's conceptual understanding of the subject area by asking 'how' and 'why' questions, and allowing children to clarify vague or incomplete responses. The interviews lasted 15-30 minutes and were tape recorded and verbatim transcribed. Neither the interviewer nor any of the children mentioned the programme 'An adventure with Pelle Pump' during the interviews. The final verification on participation in the programme was collected after the interview.

Phenomenography

Phenomenography was used to analyse the interviews. This approach was developed at Gothenburg University, Sweden in the mid-1970s as a specific approach to investigate how various phenomena actually might be conceived [111, 112]. Phenomenography aims to investigate and describe the variation of the qualitatively different ways in which people experience, understand, see, perceive and conceptualise phenomena in the lived world [113]. Phenomenography proposes that a phenomenon is understood by people in qualitatively different ways, and in a group of people there is always a limited number of ways of understanding a phenomenon [113]. In phenomenographic investigation the researcher defines, building on careful analysis of empirical data, qualitatively different categories of description with respect to ways of perceiving the phenomenon under investigation [114]. These categories and the relationships between them describe the different ways the phenomenon can be understood and form the outcome space [111, 113].

1. For me to get a chance to know a little about you, I'd like you to tell me about an ordinary weekday in your life, from the time you get up in the morning 'til you go to bed at night.
2. Are you happy with your life that you just told me about? Is there anything you would like to change?
3. What would you like your life to be in five years?
4. Can you describe to me what it feels lika to exercise, when it's fun or when it's boring? How do you feel when you really don't want to exercise, how do you feel after?
5. What is health to you? When I say the word health, what do you think about?
6. What do you have to do to get good health? What is important to get good health? What does it mean to lead a healthy life? What do you look like if you are healthy?
7. Why is it good to exercise and eat healthy food? What is the aim?
8. What is it like to lead an unhealthy life? What does it mean to lead an unhealthy life? What do you look like if you are unhealthy?
9. Can health be affected? If I came to you and asked you to give me a tip on how to get healthier, what would you tell me? What is the most important thing I have to think about?
10. Do you have anything you want to ask me about or is there anything that you think I have forgotten to ask you that you want to talk about concerning health?

Figure 2. The interview guide used in the interviews.

Data analysis

Analysis was, in accordance with the phenomenographic approach, performed after completion of all interviews. Each interview transcript was first read through by two of the authors (LCL, AS) to gain an overview of the content (familiarisation). The interviews were then concentrated and the most significant statements selected to give a short and representative version of the entire dialogue concerning health and health behaviour (condensation). The significant excerpts were compared in order to find sources of variation or agreement (comparison). The excerpts were then grouped together into different dimensions of conceptions of health and health behaviour. Answers, which appeared to be similar, were put together (grouping). The different interviews were then briefly summarised and a preliminary attempt was made to describe the essence of each interview (articulating). Following this activity two categories of description were named by trying to construct a suitable linguistic expression (labelling). These two categories constituted the outcome space.

Statistical analysis

A survey of the statistical methods used is presented in Table 6. Data were analysed using Statistica 6.0, 7.0 and SAS 9.1 for Windows. A two sided p-value <0.05 was regarded statistically significant. No correction for multiple testing was performed.

Table 6. Statistical methods used in Studies I, III and IV.

	Study I	Study III	Study IV
Descriptive statistics			
Frequency	x	x	x
Mean, SD	x	x	x
Median, Range	x	x	x
Analytical statistics			
Kruskal-Wallis test	x		
Wilcoxon's Signed Rank test	x		
Logistic regression		x	x
Chi-2 analysis		x	x

Study I

Descriptive statistical methods, median (Md) and quartiles (Q_1, Q_3), were used to describe the differences in the level of knowledge between children in the two groups. Nonparametric methods were used when analysing differences in the level of knowledge between different subsets of children (in relation to geographical and socio-economic areas and gender). The Wilcoxon rank sum test was used in analyses with two groups and the Kruskal-Wallis test when analysing more than two groups (i.e. socio-economic areas and BMI).

The differences in the means of behaviour indices between the groups were analysed using the Wilcoxon rank sum test.

Study III

The time trend analysis was performed analysing trends in health behaviours of children including cohorts from 1993, 1997, 2001 and 2003. The analysis was performed using logistic regression with time as a continuous variable. The age analysis was performed analysing trends in health behaviours of children from the 5th (age=11.5) and the 7th grade (age=13.5) in the 2001 HBSC-study and the 6th grade children (age=12.5) from the APP study in 2003. The analysis was performed using logistic regression with age as continuous variable.

A comparison of Chi-2 values was further performed, where a large value indicated greater importance.

Study IV

Each index (physical activity, nutrition and tobacco refrain) was, prior to statistical analyses, dichotomized as healthy (=1) or unhealthy (=0) behaviour. Logistic regression analyses were performed with each behaviour index as dependent variable and the predictors from the three domains as independent variables.

The relationship between the predictors in the social domain and the predictors in the intrapersonal and environmental domain was analysed using two-by-two tables. Significance levels for these tables were calculated using an ordinary chi-2 test.

Ethical considerations

Studies I, III and IV

All children were informed by their teachers that they were anonymous and they could choose not to complete the questionnaire or any of the individual questions at any time. The studies were approved by the local Ethics Committee of the Karolinska Institutet at Karolinska Hospital, Stockholm, Sweden.

Study II

The participants were ensured that they at any time, without explanation, could end the interview and that all data would be handled confidentially. The study was approved by the local Ethics Committee of the Karolinska Institutet, at Karolinska Hospital, Stockholm, Sweden.

Results

Study I

Population

A total of 2 084 questionnaires were distributed, of which 1 422 (68%) were returned. The response rate differed between the programme (n=523; 61%) and the control groups (n=846; 72%) respectively. Fifty-three of the returned questionnaires were excluded because of a lack of information on main group belonging (n=40) or missing replies to more than 20% of the questions analysed (n=13; programme, 6; control, 7). The final number of participants was 1 369 children, out of whom 523 (38%) belonged to the programme group and the remaining 846 children belonged to the control group. The inclusion process is depicted in figure 3.

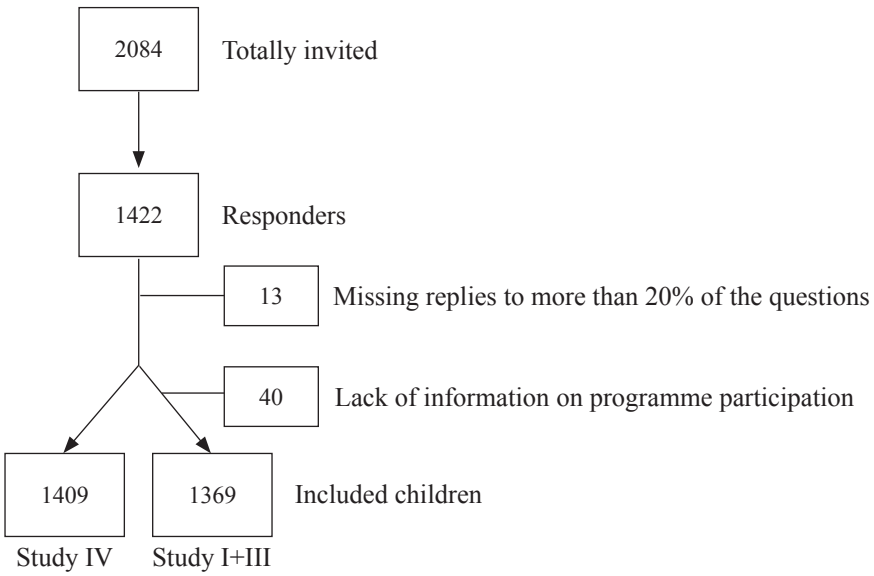

Figure 3. The inclusion process.

Table 7. Pertinent characteristics of the study groups. Variables are presented as number of subjects (n), mean, standard deviation (SD) and percentage (%).

	Programme group (n = 523)	**Control group (n = 846)**
Age (years; mean (SD))	12.5 (0.6)	12.5 (0.5)
Gender (%)		
Male/Female	51/49	49/51
Geographical area (%)		
Rural/Urban	58/42	46/54
Socio-economic area (%)		
Very affluent + Affluent	19	17
Average affluent + Average	25	29
Average neglected + Neglected	35	35
Poor + Very poor	20	19
Body Mass Index, BMI [1] (%)		
Normal	88	89
Overweight	8	9
Obese	4	2

[1] Body Mass Index (BMI) levels classified according to international cut off points for BMI for overweight and obesity by sex, defined to pass through body mass index of 25 and 30 $kg*m^{-2}$ at age 18 [107].

The characteristics of the two groups are outlined in Table 7.

An analysis of the non-responding children (n=662) revealed that they were equally distributed between urban (n=318) and rural (n=344) areas but that they were somewhat more frequently from poor socioeconomic (n=404) than wealthier areas (n=260).

Knowledge

Combining all knowledge-oriented questions (questions on health behaviours and bodily functions), children in the programme group were significantly more knowledgeable than those in the control group (Figure 4). The proportion of children who scored 8 or more points of the total possible score of 16 was 48% in the programme and 36% in the control groups ($P<0.001$). The corresponding proportions for questions on knowledge specifically related to health behaviour were 58 and 48% ($P<0.001$), and for knowledge questions on bodily functions 54 and 44% ($P<0.001$), respectively. Sex, socioeconomic or geographical area and BMI did not influence the level of knowledge.

Health behaviour

No significant differences were found between the programme and the control groups in the physical activity or the nutrition indices. However, a significant difference ($P<0.05$) was found in the tobacco refrain index to the disadvantage of the programme group (Figure 5).

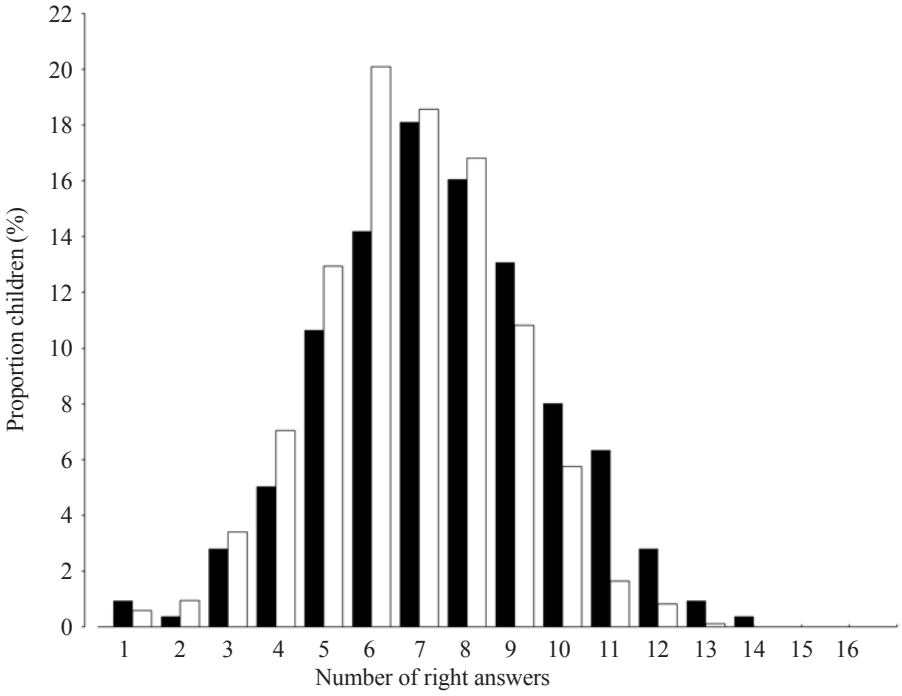

Figure 4. Proportion children with correct number of answers in control and intervention group respectively. ■ Intervention group, □ Control group.

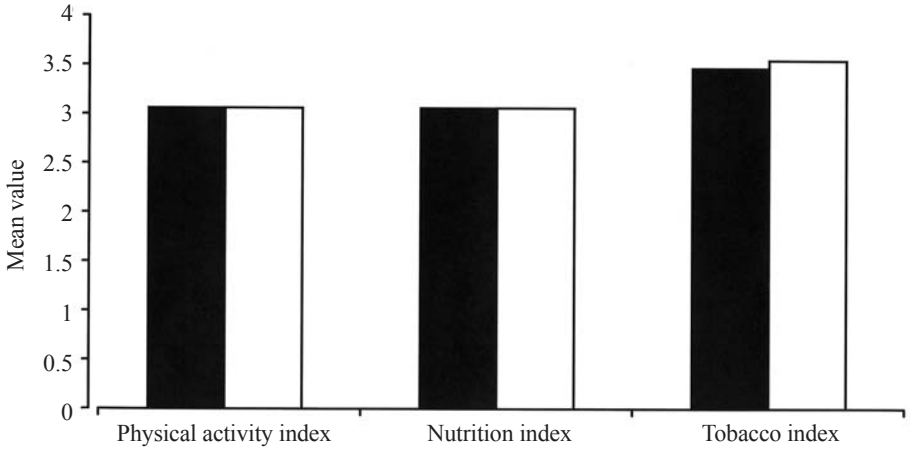

Figure 5. Differences in behaviour between the programme and control groups expressed as mean of each index (physical activity, nutrition and refraining from tobacco. The maximum possible value to be achieved was 4. ■ Intervention group, □ Control group.

Study II

Population

A total of 36 children were invited to participate in the study. Active consent was received from parents of 26 children negative consent from two parents and 18 did not respond. The final sample comprised 16 children with an equal distribution of girls and boys. Seven (girls = 4) of these children had participated in 'An adventure with Pelle Pump' (Table 8).

Table 8. Socio demographic characteristics of included children described as number of children.

Socio demographic characteristics	**Included children (n=16)**
Gender	
Girl/Boy	8/8
Age	
11 years	3
12 years	11
13 years	2
Number of siblings	
1 sibling	8
2 siblings	4
3 siblings	3
4 siblings	1
Civil status of parents	
Married/Separated	16/0
Socio economic area	
Very affluent	6
Affluent	3
Average	4
Poor	3
Very poor	0
Subjected to the programme, "An adventure with Pelle Pump"	
Yes/No	7/9

Conceptions of health and health behaviour

Two different categories for description of conceptions of health and health behaviour were identified among these 12-year old children, 'Health behaviour to avoid negative consequences' and 'Health behaviour to get positive advantages'. All children mentioned the significance of health and ill-health, which was presented as underlying conceptions of whether health behaviour foremost was a way to reach advantages in life, such as strength, youth, well-being, alertness, and happiness or to avoid risks of diseases, getting sick or obese (Table 9). The majority of the children who participated in the health education programme 'An adventure with Pelle Pump' gave response that formed the category 'Health behaviour to avoid negative consequences', whereas the majority of

the children who had not participated gave expressions that formed the category ‘Health behaviour to get positive advantages’.

Table 9. The process of articulating and labelling in the phenomenographical analysis in the present study.

Preliminary category	Final category
To avoid feeling ill	
To avoid getting obese	**Health behaviour to avoid negative consequences**
To avoid getting diseases	
To feel well	
To stay alert	
To feel happy	**Health behaviour to get positive consequences**
To stay young	
To get strong	

‘Health behaviour to avoid negative consequences’

This category presented underlying conceptions of health behaviour foremost to avoid risks of diseases, getting sick or obese. Health was seen as means to avoid future health risk and the children focused on the risk of catching a cold or falling ill if you do not have a healthy lifestyle. Unhealthy behaviours were exemplified as inactivity, to eat fatty food and to smoke. The risk of becoming obese was a concern expressed but obesity was among some children not seen as a risk for further illness merely that you would get tired and short of breath. However, some children related obesity to diseases, focusing on obesity as a risk of getting health problems. Good habits and prerequisites mentioned were exercise, healthy food, social relations, social competence and having a large social network. The unhealthy behaviours stressed were bad food, inactivity, smoking and unsocial behaviour. Obesity was seen as a barrier against social relations and thus creating psychosocial ill-health as well.

‘Health behaviour to get positive advantages’

This category contains underlying conceptions of health behaviour as a way to reach advantages in life, such as strength, youthfulness, well-being, alertness, and happiness. Health was described as a feeling of well-being, which included the experience of a good feeling about your life, body and mind in general. Well-being was expressed as a result of acting ‘normal’, not to eat bad but not too healthy either (i.e. being able to eat fast food at times) and to exercise just enough were also of great importance. The expressed components of feeling well were to have a good self-esteem and good social relations i.e. to have good friends and be able to spend time with them. Health was also related to staying alert and the children stressed the importance to stay alert in adulthood and even more in old age and exercise was pointed out as a mean to achieve this. Health was seen as equal to the feeling of happiness and therefore social relations were of importance for health. To be able to feel happy it was considered important to be nice and act unselfish as well as be a good friend to others. Health was related to the ability to stay strong but the children spoke of strength not merely in the meaning of muscular strength but also in the meaning of stamina and good shape and feeling fit. Youth was for these children seen

as a prominent characteristic of health. Ill-health was old age and then primarily to look old, not merely the age in years. To look old was to look weak and fragile and thus an indication of ill-health, and in order to stay young the children suggested that individuals need to exercise.

Study III

Population

The HBSC cohort from 1993, 1997 and 2001 consisted of 1 225, 1 294 and 1 499 children in the 5th grade (mean age 11.5) and 1 208, 1 357 and 1 201 children in the 7th grade (mean age 13.5) respectively. The APP cohort consisted of 1 369 children in the 6th grade (mean age 12.5).

Table 10. Results from the chi-2 analysis of age- and time trends for health behaviours in Swedish schoolchildren.

Behaviour	**Sex**	**Time trend analysis**		**Age analysis**	
		$\chi 2$	p-value	$\chi 2$	p-value
Physical activity	Boys	150.03	***	65.68	***
	Girls	167.99	***	85.87	***
Computer use	Boys	0.00	n.s.	27.52	***
	Girls	9.85	**	119.68	***
TV-viewing	Boys	137.72	***	0.69	n.s.
	Girls	145.99	***	4.30	*
Breakfast consumption	Boys	178.39	***	1039.25	***
	Girls	44.54	***	666.29	***
Fruit consumption	Boys	413.56	***	106.05	***
	Girls	512.44	***	12.44	***
Vegetable consumption	Boys	51.54	***	169.12	***
	Girls	32.37	***	122.85	***
Sweets consumption	Boys	184.33	***	86.67	***
	Girls	38.21	***	188.00	***
Soft drink consumption	Boys	154.31	***	35.03	***
	Girls	22.01	***	11.03	***
Tobacco smoking	Boys	33.90	***	263.07	***
	Girls	66.48	***	360.77	***

□ Indicates the highest Chi-2 ($\chi 2$) value for each behaviour and thus the strongest trend.
P-values; * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

Physical activity and sedentary behaviours

The proportion of children that were physically active at least one hour every weekday increased significantly from 2001 to 2003 ($p<0.001$). In contrast the age trend analysis revealed a decreasing proportion of physically active children with increasing age ($p<0.001$). Time trends had a more pronounced influence on physical activity than increased age (Table 10 and Figure 6).

The proportion of children watching television more than one hour per day on weekdays decreased from 2001 to 2003 ($p<0.001$). Likewise increasing age resulted in decreased time watching television (girls $p<0.05$). In this respect time trends was of greater importance than increased age (Table 10 and Figure 6). From 2001 to 2003 there was a non-significant trend towards less computer use on weekdays among boys but an increase among girls ($p<0.01$). The age trend analysis revealed a decrease in time spent using the computer with increased age ($p<0.0001$). This change was more substantial than that seen over time (Table 10 and Figure 6).

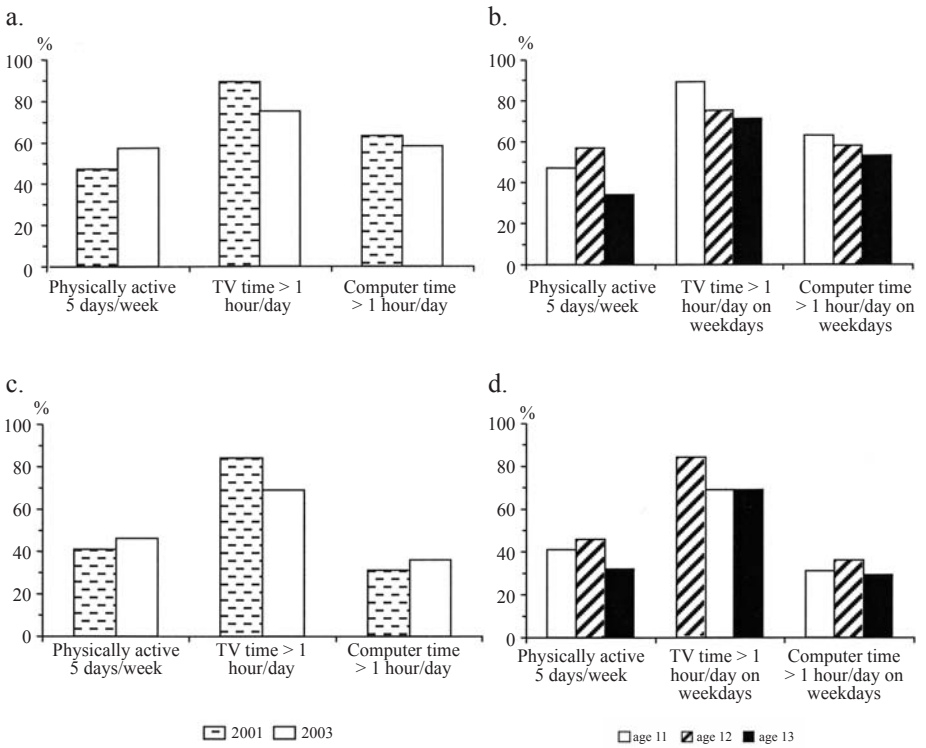

Figure 6. Time and age trends in physical activity and sedentary behaviours.
Proportion children with high frequencies of physical activity, television viewing and computer use, described in;
a. Time trends on physical activity and sedentary behaviours of boys; b. Age trends on physical activity and sedentary behaviours of boys; c. Time trends on physical activity and sedentary behaviours of girls; d. Age trends on physical activity and sedentary behaviours of girls

Dietary variables

As depicted in Figure 2 regular breakfast habits declined among both boys ($p<0.001$) and girls ($p<0.001$) from 2001 to 2003. This decrease was also related to increasing age ($p<0.001$) with age of greater importance than time trends (Table 10 and Figure 7).
A decline in fruit intake ($p<0.001$) was seen from 1993 to 2003. Although there was an age dependency with decreased fruit intake by increasing age ($p<0.001$) time was of greater importance (Table 10 and Figure 7).
An overall increase in vegetable intake ($p<0.001$) was seen from 1993 to 2003 with a decline from 2001 in boys and 1997 in girls. An increase in age resulted in a decrease in vegetable intake with age ($p<0.001$) of greater importance than time trends (Table 10 and Figure 7).

Daily sweet consumption was low during the complete period. Still there was a decrease from 1993 to 2003 ($p<0.001$). An increased consumption with increased age ($p<0.001$), was seen among both boys and girls. Time trend was of greater importance than age for boys a, in contrast to girls where age was more important (Table 10 and Figure 7).

A decrease in the proportion of children consuming soft drinks daily similar to the one in sweet consumption ($p<0.001$), was seen from 1993 to 2003. The age trend analysis revealed an age dependency of increased consumption by age for boys and decreased

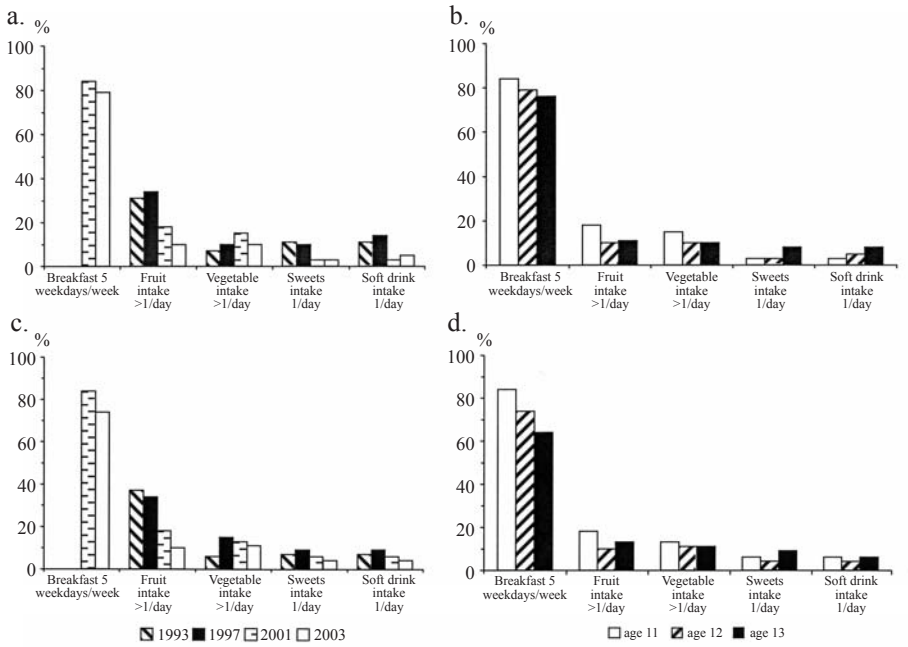

Figure 7. Time and age trends in dietary patterns.
Proportion children with high consumption of breakfast, fruit, vegetables, sweets and soft drink described in;
a. Time trends on dietary patterns of boys; b. Age trends on dietary patterns of boys; c. Time trends on dietary patterns of girls; d; Age trends on dietary patterns of girls

consumption for girls ($p<0.0001$) but time trends was, despite low changes and low consumption, of greater importance than age (Table 10 and Figure 7).

Smoking

Time and age trends in smoking behaviours for both boys and girls are illustrated in Figure 3. More children ($p<0.001$) had tried smoking at least once in 2003 than 2001. The proportion of children having tried smoking at least once increased with age ($p<0.001$) and age was of greater importance for the development of tobacco habits than time trends (Table 10 and Figure 8).

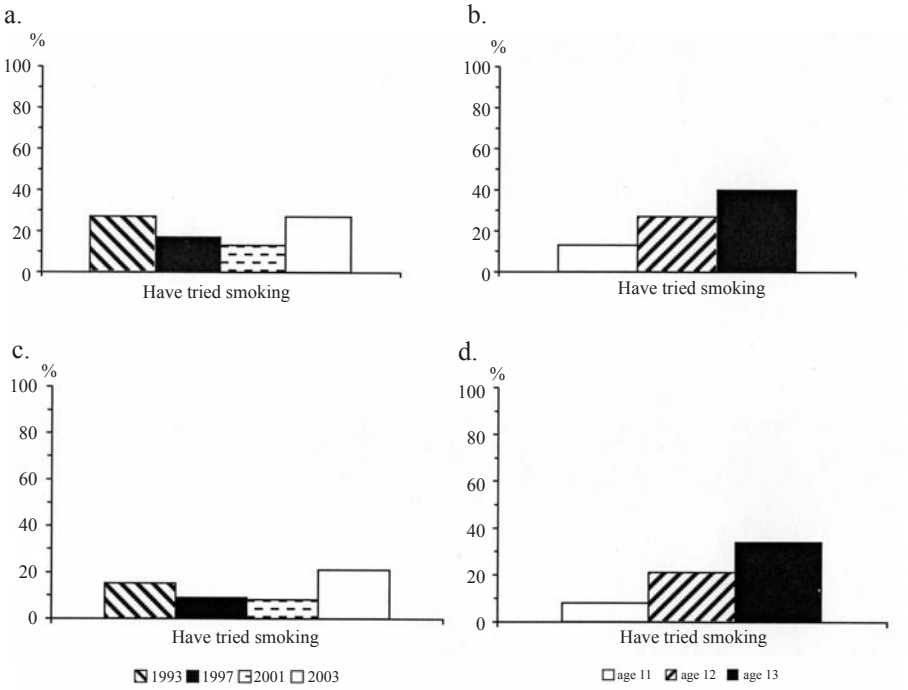

Figure 8. Time and age trends on smoking habits
Proportion children having tried smoking at least once, described in;
a. Time trends on smoking of boys; b. Age trends on smoking of boys; c. Time trends on smoking of girls; d; Age trends on smoking of girls

Study IV

Population

A total of 2 084 questionnaires were distributed of which 1 422 (68%) were returned. Thirteen of the returned questionnaires were excluded because of missing replies to more than 20% of the questions analysed. The final number of children included in the present study was 1 409 with a mean age of 12.5 years. Characteristics of the included children are presented in Table 11.

Table 11. Pertinent characteristics of the included children presented in percentage (%), unless otherwise stated.

Predictors	Included children (n = 1409)
Intrapersonal domain	
Gender (boys/girls)	50/50
Age (years; mean (SD))	12.5 (0.6)
Body Mass Index, BMI [1] (normal/overweight + obese)	88/12
Social domain	
Source of inspiration to be physically active (yes/no)	
Coach	20/80
Family	51/49
Physical education teacher	15/85
Media	9/91
Yourself	71/29
Someone else (dog, idol or someone else not previously listed)	11/89
Maternal attention to the child's eventual smoking	
Low level/high level of attention	7/93
Paternal attention to the child's eventual smoking	
Low level/high level of attention	14/86
Environmental domain	
Socio economical living area	
S1 = Very affluent + affluent	18
S2 = Average affluent + average	28
S3 = Average neglected + neglected	35
S4 = Poor + very poor	19
Geographical living area (rural/urban)	50/50

[1] Body Mass Index (BMI) levels classified according to international cut off points for BMI for overweight and obesity by sex, defined to pass through body mass index of 25 and 30 $kg*m^{-2}$ at age 18 [107].

Predictors of healthy behaviours

As depicted in Figure 9, all domains studied, i.e. intrapersonal, social and environmental, influenced health behaviours. A normal BMI was connected to a beneficial tobacco index ($p<0.04$). The physical activity index was higher for children who perceived your *family* ($p<0.0001$), *yourself* ($p<0.0001$) or *someone else* ($p<0.003$) as sources of inspiration to be physically active. Paternal ($p<0.005$) and/or maternal ($p<0.001$) attention to the children's tobacco use was of importance for children to refrain from tobacco. To live in a socio economically wealthy area was beneficial for the nutrition ($p<0.002$) as well as the physical activity indices ($p<0.04$). Children from rural ($p<0.005$) areas were more physically active than children from urban areas.

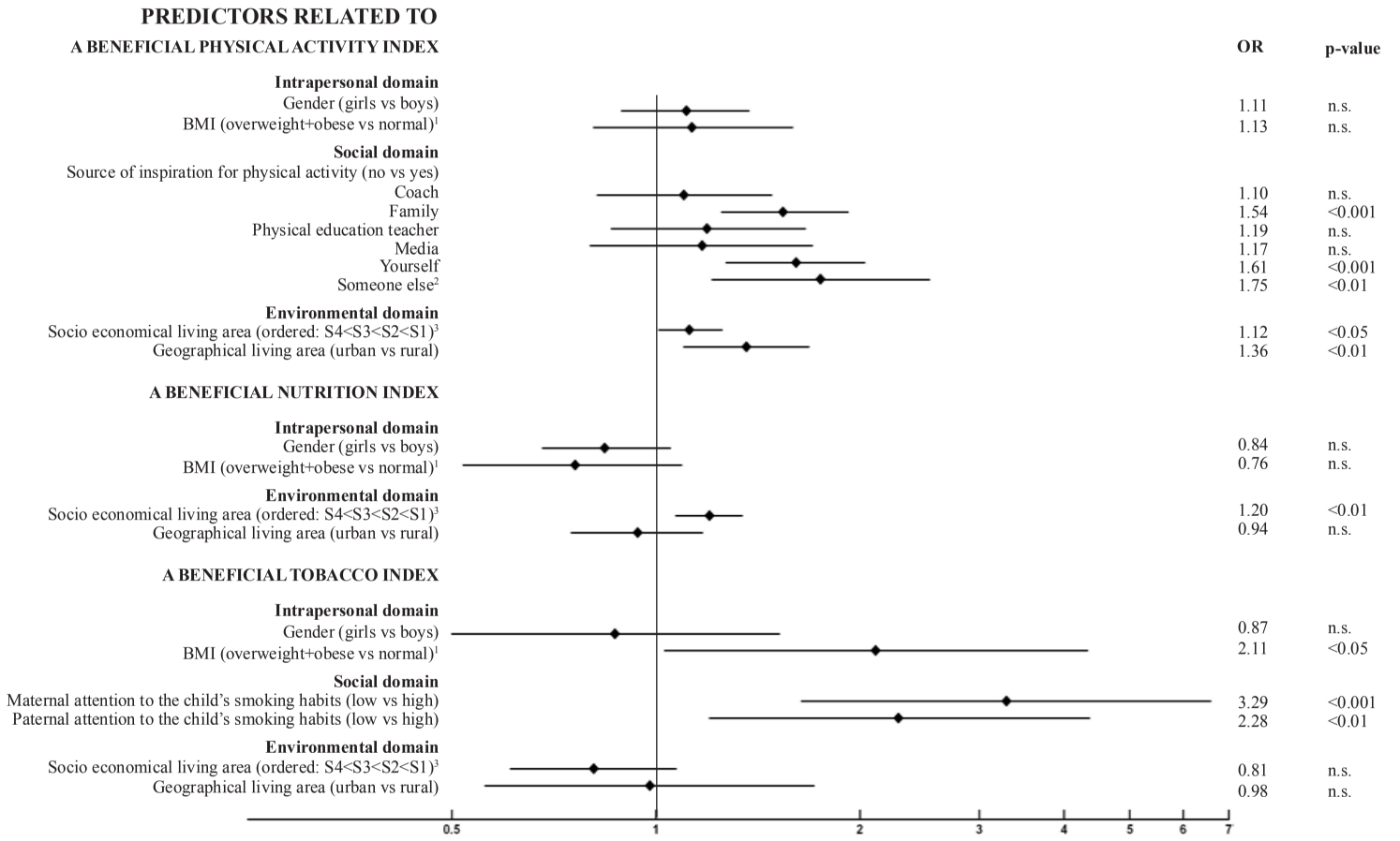

Figure 9. Odds Ratio of impact of predictors on life style habits, i.e. physical activity, nutrition and tobacco. A high index value equals a healthy behaviour.
[1] BMI levels classified according to Cole et al. [107]. [2] Someone else = dog, idol or someone else not previously mentioned. [3] Socio economical living area; S1 = very affluent + affluent, S2 = average affluent + average, S3 = average neglected + neglected, S4 = poor + very poor

The distribution of social predictors, based on the intrapersonal and environmental predictors, in different groups of children, is described in Table 12. Socio economical living areas very affluent to neglected (S1-S3) were merged, as differences were considered low between these groups of children, and thereafter compared to poor and very poor living area (S4) in these analyses. As seen in Table 12, perceiving *yourself* as a source of inspiration for physical activity varied significantly between all groups of children. Perceiving *yourself* of great importance to be physically active was most frequent among girls (75%) and children living in urban settings (75%) and less frequent among children living in socio economically poor and very poor areas (62%) and overweight and obese children (60%).

Table 12. Proportions (%) of the connection between intrapersonal and environmental predictors with social predictors.

	Social domain							
	Source of inspiration for physical activity						**Perception of high parental attention to tobacco use**	
Determinant	***Coach***	***Family***	***PE-teacher*[1]**	***Media***	***Yourself***	***Someone else*[2]**	**Maternal attention**	**Paternal attention**
Overall proportion (%)	20	51	15	9	71	11	93	86
Intrapersonal domain								
Gender (%)								
Boy	22 *	50	13	9	67 **	12	92	84
Girl	18	53	17	9	75	10	92	85
BMI[3](%)								
Normal	21	52	15	10 ***	73 ***	11	93 *	86
Overweight/ Obese	16	46	11	3	60	5	87	81
Environmental domain								
Socio economical living area[4] (%)								
S1-S3	18	51	14	8	73 ***	10	96 *	92
S4	27	52	19	12	62	14	98	96
Geographical living area (%)								
Urban	21	50	15	8	75 ***	9 *	92	86
Rural	19	53	15	10	66	12	91	83

[1] PE-teacher = Physical Education teacher. [2] Someone else = dog, idol or someone else not previously mentioned. [3] Body Mass Index (BMI) levels classified according to international cut off points for BMI for overweight and obesity by sex, defined to pass through body mass index of 25 and 30 kg*m-2 at age 18 [107].
[4] The distribution of social variables in socio economical living areas S1-S3 (very affluent - neglected) was low and therefore these three groups were merged and thereafter compared to S4 (poor + very poor) in the chi-2 analysis.
Differences between groups of children are described as: * = $p \leq 0.05$, ** = $p \leq 0.01$, *** = $p \leq 0.001$; unmarked proportions = differences not significant.

General discussion

The main findings of this thesis were 1) that the knowledge based health intervention programme 'An adventure with Pelle Pump' had a positive impact on knowledge and attitudes but did not affect health behaviours; 2) that health behaviours deteriorates rapidly with increasing age in the studied span between 12 of 14 years of age; 3) that secular trends are important for health behaviours in young children; and 4) that parental support is very influential for children when making healthy life style choices.

Before discussing the outcomes and implications of this thesis there is a need to address some methodological issues.

Study design and sample

The questionnaire

Various aspects on and factors of potential importance for health behaviours were evaluated in a large group of children in studies I, III and IV, which were based on the same sample of children. The plan was to recruit a large group of Swedish children from different geographical and socio-economic areas. Accordingly, and as outlined in the introduction, the most feasible assessment tool was a questionnaire. Still the limitations with this type of evaluation, such as the potential for self-report bias and errors in recall, need to be recognised when interpreting study outcome. Only nine percent of the present cohort of children was overweight and three percent obese, proportions that are about half of those presented in previous Swedish reports [115, 116], however similar to those reported in the 'Health Behaviour in School-Aged Children' cohorts [117]. This might be a result of the nature of data collection since it has been reported there is a systematic propensity for overweight and obese persons to underestimate their body size [118]. On the other hand, validity studies on the use of self-reported questionnaires in the youth population concluded that these methods are valid when confidentiality is assured as was the case in the present investigation [119-122].

The content validity of the present questionnaire was secured in two steps. The initial testing was performed in a pilot population of 45 10-year-old children from schools with

similar backgrounds as those included in the study. Secondly, two nine year old girls were asked to describe their interpretation of the questions. In order to secure the understanding of the questions children participating in the validation process were intentionally selected to be somewhat younger than the study population. Some questions were rephrased after the validation process to ensure correct interpretation.

Populations

A strength of Studies I, III and IV is the large number of participating children chosen to represent different socio economic and geographical living areas. The large number of participants was indeed a prerequisite to obtain a representative sample of 12-year old Swedish schoolchildren. This goal was accomplished as far as geographical and socio economical living areas concerns. Although an extended analysis of the non-reply group (n=662) revealed that these children somewhat more frequently lived in poor socio economical (n=404) than in wealthier areas (n=260), the finally included children were normally distributed as regards socio economical living area. The most likely explanation is that more children originated from socially neglected than wealthier living areas in the totally invited sample of children (n=2084).

In the comparison between children who participated or not in 'An adventure with Pelle Pump' the distribution of responses was, due to factors beyond our control, somewhat uneven with more participating children belonging to the control than the programme group respectively. This related to a change of the principles for transfer of Swedish school children between classes at the intermediate and senior school levels at an age of 12–13 years. To keep the original classes as untouched as possible, the programme evaluation was planned to be completed before this transfer. The transfer was, however, brought forward to the age of 11–12 years in a many Swedish schools during the planned evaluation of the programme, changing the conditions for the investigation by combining children, exposed and not exposed to the programme, in the same classes. By coincidence more unexposed children were transferred to classes that, according to the original records, had participated in the programme. Since it was an, for the investigators, unforeseen change the uneven distribution of replies was not discovered until all questionnaires had been returned. The actual reason behind the unexpected uneven distribution was indeed disclosed only following a subsequent analysis of potential reasons for the lower response rate from exposed children (61%) than from those not exposed (72%) to the programme. Anyhow, it is reassuring that a majority of lost replies was not related to individual unwillingness to participate because this could have introduced a selection bias towards more engaged participants. Looking specifically at the distribution between the intervention and the control groups, the children were evenly distributed as regards socio economical living areas. Nevertheless the described recruitment problems may be the reason behind an uneven geographical distribution with responders in the control group somewhat more frequently originating from rural areas. The most important impact seems to be that the number of programme participants became less than expected. Still this population comprised a substantial number of children (n= 523) making it unlikely that an increased sample size would have changed study outcomes.

It may seem as the response rate in the present investigation (68%) differs from the corresponding proportions in the 'Health Behaviours in School-Aged Children' studies. However, their method of calculating lost replies differed from that in the present

investigation by being based on the actual number of responding classes rather than those invited. In preparation for study III the response rate from 'An adventure with Pelle Pump' was recalculated according to these principles and then amounted to 90 percent, which is very similar to the 'Health Behaviours in School-Aged Children' studies [29]. The lack of an analysis of the non responders in the different 'Health Behaviours in School-Aged Children' cohorts may be considered as a limitation but the high response-rate, 85-90%, enhances the general applicability of the results.

Although the intention in study II, the interview study, was to recruit children from different socio economical living areas this was not completely accomplished. In this respect the representativity in our findings may be limited, as we received no responses from parents to children living in the poor areas of Stockholm. Noteworthy is also the surprising finding that all participating children in study II lived with both their parents. According to Swedish official statistics from 2002 more than 29 percent of Swedish children, aged 6-12, did not live with both their parents [123]. These selection biases may be explained by the fact that people from higher economic groups and living in more stable social conditions are more likely to pay attention to the health related factors investigated in the present study and therefore more willing to participate. A more substantial participation of children with divorced parents or from lower socio economic areas might have influenced the outcome in a, for future health, partially negative sense as already indicated by the present results. It underlines the need to extend observations to other parts of the population in which attitudes to a healthy lifestyle may be based on other prerequisites and beliefs.

Most efforts to prevent disease and promote health among school-age children and adolescents have been implemented in school settings. While school-based studies demonstrate a positive short-term impact, the brevity of the follow-up time seldom permits the assessment of long-term effectiveness. 'An adventure with Pelle Pump' was evaluated two years after programme implementation, which may be considered quite long in the context of previously available programme evaluations [61, 62, 124]. To be consequential, effects must be notable after a long period of time and it has been advocated that evaluations should succeed six months to be meaningful [71]. However, two years may still seem short considering the time it takes to develop cardiovascular disease. It is unlikely that the present study would have had a different outcome if the follow-up time had been longer. On the contrary it is reasonable to assume that the effects of the programme would have been even more diluted.

'An adventure with Pelle Pump'

The Swedish health education programme 'An adventure with Pelle Pump' was conducted from 2000 to 2005. More than 400 000 ten year old children have participated during these years. Teachers with shown interest were provided with well produced printed material including a tutor manual and booklets for the pupils. This popular programme was well received in schools across Sweden. The present evaluation of the impact of the programme was initiated by the Swedish Heart and Lung Foundation, who were responsible for and financed the programme.

'An adventure with Pelle Pump' may be seen as a programme based on the assumption that improved knowledge will influence behaviour. In 1935 Allport [125] presented the classic model linking information and attitudes to subsequent behaviour. This model postulated that acquired knowledge about a behaviour will cause an attitude leading people to develop of a predisposition to respond, which in turn induces a behaviour an agreement with the attitude. According to this theory, knowledge of health risks and benefits is assumed to be a prerequisite for adopting beneficial or when needed modifying less beneficial habits. If people lack knowledge about how their lifestyle affects their health, they have little reason to accept the effort of changing the unfavourable habits they like to enjoy [58]. This model has been challenged by Bettinghaus [126], forfeiting the opinion that the positive relationship between knowledge, attitude and behaviour is smaller than originally expected. This controversy made it of particular interest to evaluate the outcome of the knowledge based health education intervention 'An adventure with Pelle Pump' on changes in attitudes, knowledge and behaviours.

As regards attitudes, the children, who had participated in 'An adventure with Pelle Pump', were aware of health risks and seemed to have a deeper knowledge and understanding of health and the long-term effects of health behaviour. Thus, this programme had altered their attitudes towards health and health behaviour. It may, however, be discussed what is best for future health among children: to, at this early stage be made aware of health risks caused by unhealthy behaviour, or to focus on their present health status advocating a healthy lifestyle to gain momentary benefits hoping that this will create long lasting beneficial habits. Further it may be debated whether 12-year old children indeed need to be aware of future risks for disease or if this may create frustration and uncertainty. However, considering the global and rapidly increasing prevalence of childhood obesity [6], it seems unavoidable to inform children of future health risks connected to overweight. Information and education of future disease risks do also seem inevitable due to the accumulating knowledge that poor dietary habits and sedentary lifestyle founded at young age are preserved through life [127, 128]. These habits will actively contribute to the premature development of chronic diseases including cardiovascular disorders, type-2 diabetes and some types of cancer [2].

Changes in attitudes which hopefully involves interest for and a behavioural change or a retained health behaviour, is preceded by an increase in knowledge [129]. Knowledge is an ambiguous word. Traditionally it has been defined as the quantity of things that a pupil has been taught and can repeat at an examination. Knowledge in a wider definition is considered as flexible, to be looked at as a process and seen as a quality to have the ability to reflect and understand context, draw conclusions and put them into practice [130]. Knowledge is difficult to measure and there are no standardized instruments developed for this purpose. Thus, researchers have to develop their own, specific tools when studying this entity. Perhaps knowledge as a concept needs to be widened and include skills. Skills are likely to have a greater impact on behaviour than pure theoretical knowledge. Having said this, an acquirement of knowledge by itself is likely to be of some importance for a behavioural change, however it is not enough [129]. This is in concordance with other reports where no evidence was found to support that increased knowledge induced changes of behaviour [131, 132] or could indeed verify that a change in knowledge actually is mandatory before a change in behaviour may be expected [129]. This information together with the present

findings gives support that theoretical education is insufficient to gain success in inducing healthy habits.

Another potentially important factor for the lack of effect on health behaviour is the way the programme was implemented in the practical situation. 'An adventure with Pelle Pump' was implemented in the school setting as classroom curricula and teachers were free to use the provided material, teacher manual and booklets for all pupils, whichever way they preferred. Although beyond the scope of the present evaluation it is a pity that the programme never was subject for a proper methodological evaluation since the structure of program implementation may impact the specific intervention strategies, explain study outcomes [133, 134], and infer the success or failure of the intervention [133-135].

'An adventure with Pelle Pump' was carried out during a limited time period each year from February to May, and teachers were provided information and suggestions on curriculum activities. An internal Internet-based evaluation (Swedish Heart and Lung Foundation, 2004, unpublished report) on the use of the material revealed that 82% of the teachers used the distributed material during scheduled classes, 45% as group projects and 67% to create a day devoted to a particular theme or topic. Thus, time spent on teaching with the material as a basis varied considerably, making the programme group heterogeneous from an educational point of view. A more homogenous educational structure, in time and format, may perhaps have had a greater impact on health behaviours. It is indeed difficult to develop a health intervention programme for a heterogeneous group with widely varying health beliefs, as was attempted in the present programme. More effective interventions have had a lower participation rate and has been performed in fewer, larger schools [124]. Thus methodological issues may, at least to some extent, explain the weak results in behavioural changes, with the present programme.

Interventions that are delivered at schools are greatly dependent on the school environment, including such factors as physical resources, attitude and experience of teachers and school directors. Thus the impact of an interventional programme cannot be generalized unless these factors are addressed in the design [136]. The current health education intervention was implemented on a voluntary basis. All 4th grade teachers in Sweden were invited to the programme to be equipped with study material after shown interest. Accordingly it is reasonable to assume that participating teachers were indeed interested and found this initiative of great importance for their pupils. Further, each class was provided a booklet with suggestions of games for recess periods with the aim to increase physical activity during recess thereby enhancing the utilisation of minimal resources, i.e. schoolyards. The recess periods promote physical activity, by simply getting children outdoors [62]. A positive correlation has been found between the time young children spend outdoors and their levels of physical activity [137].

Predictors for health behaviours

As no behavioural differences were discovered between the Control and the Intervention groups in the evaluation of 'An adventure with Pelle Pump', these groups were merged

to broaden and increase the power in the analysis of predictors and trends of time and age on healthy habits.

The education based health intervention programme 'An adventure with Pelle Pump' focused on factors within the individuals, such as knowledge, attitudes and behavioural change. When originally studying the content of this programme we were unable to identify a theoretical model based upon which the programme had been built. This may be another explanation to the lack of effect. To be truly successful, interventions need to be based on theories that strongly emphasise the role of the environment in influencing behaviours [129, 138]. Importantly programmes aiming for more beneficial habits at an individual level do not alter the social and environmental conditions that may promote and maintain the behavioural risks in focus of the intervention [139]. Programmes based on the information on behavioural predictors of health behaviours aiming to be altered are likely to be more successful in producing individual health behaviour changes, since they are inspired by a theoretical explanation of the links between behavioural determinants indicating how interventions should be implemented [140]. In tackling the predictors of health, health promotion includes both actions towards changing the predictor of immediate control of the individual, including individual health behaviours, and those factors outside of the control of the individual, including social, economy and environmental conditions [141]. It was, therefore, of great interest to assess the intra- and extra-individual predictors for health behaviours of Swedish school children.

An ecological model was identified and applied when studying correlates for physical activity, [110, 142]. This model hypothesizes that physical activity is influenced by three domains: (a) intrapersonal (biological, psychological, and behavioural influences), (b) social (family or peer support, modelling), and (c) environmental (facilities, communities, accessibility, etc.) [104]. The three studied health behaviours in Swedish school children were, when applied in this ecological model, found to be influenced by each of the three domains (Figure 10)
An important finding was that the window of opportunities to change health behaviours in children seems to be very narrow. Already an increased age from 11.5 to 13.5 years related to considerable decreases in healthy behaviours. This makes early initiation and

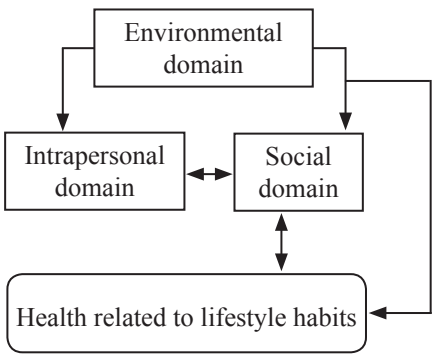

Figure 10. Modified version of the ecological model of physical activity after Spence et al. [110], when applied on all three studied health behaviours (physical activity, nutrition and tobacco use).

continued efforts mandatory in any attempt to counteract age dependent changes and create a prerequisite for long lasting habits with a capacity to prevent future ill-health and subsequent disease.

Further, social support from parents and families combined with self confidence was essential for children to be physically active and to refrain from tobacco. A somewhat surprising finding was the limited importance of the physical education teachers for the children to be physically active. Whether this relates to the numerous cut backs in physical education lessons during the last decade or not is unclear. Teachers may turn children away from healthy habits by a less insightful physical education, or by paying to much attention to competitive rather than health promoting activities [142, 143]. Engaged and knowledgeable teachers and coaches can and should have a strong and favourable influence on the young generation thereby reinforcing parental efforts. Today's parents have longer work hours, and many families consist of only one parent. Thus, in modern society parents increasingly need to rely on schools and similar institutions to take on great responsibilities when it comes to teaching their children on health variables as diet and physical activity. This underlines the importance of including families and to have a comprehensive intervention, including the entire school and environment when implementing health intervention programmes in the school setting.

Regarding the impact of the environment on health behaviours, children from wealthy or rural areas had a higher reported physical activity than those from less affluent or urban areas. One explanation may be that children from more deprived areas do not have the same physical activity and recreation opportunities, including fewer convenient facilities for physical activity, compared to children from higher income families [142, 144]. Further, industrialization increases transportation involving less energy expenditure, which contrasts to the means of transportation for children in rural areas and may explain their higher levels of physical activity within their daily life.
The only predictor, significantly related to healthy food habits, was to live in a socio economically wealthy area. This might be explained by the fact that family income can present a barrier to healthy eating. It may also be that parents with higher socio economical status often have a higher education level and greater interest in these matters. Children in lower socio economical groups consume less fruit and vegetables and have a higher intake of fat compared to children from more affluent areas [145]. As many as 40% of adolescents with lower income background did not meet the recommended daily consumption of fruit and vegetables [146]. Consequently, promoting healthier food choices among children requires a multi-faceted approach targeting children, parents, families and schools supported by societal and political approaches not the least as regards marketing and pricing [40].

Secular trends in health behaviours

Secular trends reflect the magnitude and force of factors such as industrialization, societal evolvements, media influence and economic assets, all influencing the behaviour of young people in a modern industrialized society.
Contrasting contemporary media reports, a positive time trend was found in some health

behaviours as reflected by an increase in physical activity and a decrease in sedentary behaviour and the consumption of soft drink and sweets. Disappointingly the consumption of breakfast, vegetable and fruit decreased. The encouraging development as regards physical activity and inactivity may relate to extensive health promotion strategies, such as the "Bunkeflo project" and "Put Sweden on Move", aiming at increasing physical activity among Swedish school children during the last decade [147], whereas fruit and vegetable consumption have not been promoted as extensively. Thus, promotion strategies have the potential to influence physical activity of children when implemented in the right context, and in a larger perspective it seems as food habits need more attention early in life.

Tobacco use decreased from 1993 to 2001 but increased from 2001 to 2003. As previously described it was not possible to completely isolate the impact of time and age from each other, and the explanation may be differences in age in the examined cohorts. To limit the influences of age the analysis was adjusted for time and age, and the outcome of this nalysis did not change this impression. This conclusion gains support by a recent report on a decline in smoking from 1989 to 2003 among Swedish adolescents [148]. However, tobacco use needs constant attention in the youth population as the initiation of smoking prior to teenage years is clearly associated with regular smoking later in life [50]. In Sweden, the organisation 'A Non-Smoking Generation' have offered constant information and intervention programmes targeting schoolchildren during the last decades, resulting in a low prevalence of smoking among Swedish children compared to other European countries [149], underlining that an early initiation and longitudinal efforts can be effective and are indeed needed to institute and preserve healthy habits among children and adolescents.

Taking into consideration all of the above illustrated secular trends, behaviour programmes targeted at individuals require ongoing funding and resources if they are to have a sustained impact on long term behaviours and counteract the impact of time health initiatives need to be reinforced and continued over time.

Future implications

This thesis provides results of a comprehensive health education programme with the intention to influence three important life style habits; physical activity, healthy food choices and refrain from tobacco. In line with earlier studies it revealed that knowledge-based interventions implemented in the school settings can improve knowledge and attitudes towards a healthy lifestyle. Health behaviours were, however, not affected by the intervention. Importantly, this thesis demonstrated that the window of opportunity for promoting health behaviours is narrow and, to be successful, interventions need to be implemented at an early age. Interventions to promote a healthy lifestyle should target children within the school setting, as it is a place where all children, regardless of weight, health interest or socioeconomic background, easily can be reached. Parents need also to be involved, since parental support is of utmost importance for children to make healthy life choices, as shown in this thesis. Health prevention interventions should be multi-faceted, combining classroom programme with environmental changes in the school, home or community. Further health intervention programmes must focus not only on communicating knowledge but also include strong elements focused directly on healthy behaviours and their prerequisites.

"If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health"

Hippocrates 460-377 BC

Conclusions

- Two years after completion of the health education programme ‘An adventure with Pelle Pump’ knowledge on bodily functions and healthy behaviours were still improved compared to children without participation, however, without impacting health behaviours.

- The health education programme ‘An adventure with Pelle Pump’ was found to have an impact on children’s conceptions of health, and may therefore be of importance for their future attitudes to healthy behaviours.

- Health behaviours in children are influenced by time and age. Increasing age had a negative influence on health behaviours, underlining the importance of early initiation of health promotion.

- Parental attitudes, living areas, and to have confidence in yourself increase the propensity of children to be physically active, make healthy food choices and refrain from tobacco in children.

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