A Child-Centred Health Dialogue for the prevention of obesity

Feasibility and evaluation of a structured model for the promotion of a healthy lifestyle in preschool children and their families in the Swedish Child Health Services

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A Child-Centred Health Dialogue for the prevention of obesity

Feasibility and evaluation of a structured model for the promotion of a healthy lifestyle in preschool children and their families in the Swedish Child Health Services

Mariette Derwig

DOCTORAL DISSERTATION

by due permission of the Faculty of Medicine, Lund University, Sweden.
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Professor Boel Andersson Gäre, Jönköping University
Title and subtitle: A Child-Centred Health Dialogue for the prevention of obesity – Feasibility and evaluation of a structured model for the promotion of a healthy lifestyle in preschool children and their families in the Swedish Child Health Services.

Abstract
Prevention of childhood obesity with its effects on children’s mental and physical health and wellbeing is an international public health priority and is suggested to be effective when started early. The overall aim of this study was to develop an evidence-based child-centred multicomponent model that can be used in the Child Health Services to promote a healthy lifestyle in families and prevent obesity in preschool children. The Medical Research Council’s guidelines for developing complex interventions were used to design two studies.

A feasibility study was set up with a quasi-experimental cluster design comparing usual care with a structured Child-Centred Health Dialogue (CCHD). A total of, 203 children at three Child Health Centres received the intervention and were compared to a register-control group at eight matched centres consisting of 582 children. The results showed that both the universal and the targeted part of CCHD were feasible. Training and recurrent tutorial sessions with room for reflection strengthened nurses’ confidence and security in executing CCHD.

In a cluster-randomised controlled trial including an economic evaluation, 37 Child Health Centres were randomly assigned to deliver usual care or CCHD. A total of, 6,047 children with a mean age of 4.1 years [SD=0.1] were included, consisting of 4,598 children with normal weight and 490 children with overweight. At follow-up, at a mean age of 5.1 years [SD=0.1], there was no intervention effect on zBMI-change for children with normal weight. In children with overweight the intervention effect on zBMI-change was -0.11(95% CI: -0.24 to 0.01; p=0.07). The estimated additional costs for children with overweight were 167 euros per child with overweight.

Qualitative interviews and non-participatory observations exploring the experiences of 21 children who participated in CCHD showed that children participated as social actors and wanted to understand the meaning of the health information. The study revealed that 4-year-old children given the opportunity to speak for themselves interpreted some of the illustrations, developed by adults differently than the intended meaning.

Parents of 1,197 children, including 1,115 mothers and 869 fathers responded a survey that measured perceived parental self-efficacy. Mothers showed an intervention effect on perceived self-efficacy in promoting physical activity of 0.5 (95% CI: 0.04 to 1.0; p=0.046). A subgroup of mothers with increased self-efficacy showed an intervention effect on zBMI-change in normal weight children of -0.13 (95% CI: -0.26 to -0.01; p=0.04) and a decreasing tendency in zBMI-change of -0.50 (95% CI: -1.08 to 0.07; p=0.08) in children with overweight or obesity.

To conclude, the intervention performed in a real life setting did not show an effect on zBMI in children with normal weight, but demonstrated a decreasing tendency in zBMI in children with overweight 12 months after the intervention, albeit statistically uncertain. The additional costs for the provision of CCHD and the training of health professionals in the model could be considered a cost-effective investment in the future health of children with overweight. This thesis supports the view that children are capable of making health information meaningful and can take an active role in their health. It demonstrates the importance of a child centred approach, respecting children as social actors in the context of their families and using tools that strengthen the child and the family’s health literacy.

Key words: child-centered care, child obesity prevention, cost-effectiveness, family-based, health literacy, primary care

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Date 8th of November, 2021
A Child-Centred Health Dialogue for the prevention of obesity

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Mariette Derwig
Cover illustration: *The health dialogue about lifestyle and weight is a balancing act*
by Carin Carlsson (carin.carlsson1@gmail.com)

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Abstract

Prevention of childhood obesity with its effects on children’s mental and physical health and well-being is an international public health priority and is suggested to be effective when started early. As Child Health Services lack an evidence-based model, there is the need for development of a low-intensive health promotion model that is feasible and cost-effective in preventing obesity in preschool children.

The overall aim of this study was to develop an evidence-based child-centred multicomponent model that can be used in the Child Health Services with the aim of promoting a healthy lifestyle in families and preventing obesity in preschool children. The Medical Research Council’s guidelines for developing complex interventions were used to design two studies.

A feasibility study was set up with a quasi-experimental cluster design comparing usual care with a structured Child-Centred Health Dialogue (CCHD). A total of 203 children at three Child Health Centres received the intervention and were compared to a register-control group at eight matched centres consisting of 582 children. The results showed that both the universal and the targeted part of CCHD were feasible. Training and recurrent tutorial sessions with room for reflection strengthened nurses’ confidence and security in executing CCHD.

In a cluster-randomised controlled trial including an economic evaluation, 37 Child Health Centres were randomly assigned to deliver usual care or CCHD. A total of 6,047 children with a mean age of 4.1 years [SD=0.1] were included, consisting of 4,598 children with normal weight and 490 children with overweight. At follow-up, at a mean age of 5.1 years [SD=0.1], there was no intervention effect on zBMI-change for children with normal weight. In children with overweight the intervention effect on zBMI-change was -0.11(95% CI: -0.24 to 0.01; p=0.07). The estimated additional costs for children with overweight were 167 euros per child with overweight.

Qualitative interviews and non-participatory observations exploring the experiences of 21 children who participated in CCHD showed that children participated as social actors and wanted to understand the meaning of the health information. The study revealed that 4-year-old children given the opportunity to speak for themselves interpreted some of the illustrations, developed by adults differently from the intended meaning.
Parents of 1,197 children, including 1,115 mothers and 869 fathers, responded to a survey that measured perceived parental self-efficacy. Mothers showed an intervention effect on perceived self-efficacy in promoting physical activity of 0.5 (95% CI: 0.04 to 1.0; \( p=0.046 \)). A subgroup of mothers with increased self-efficacy showed an intervention effect on zBMI-change in normal weight children of -0.13 (95% CI: -0.26 to -0.01; \( p=0.04 \)) and a decreasing tendency in zBMI-change of -0.50 (95% CI: -1.08 to 0.07; \( p=0.08 \)) in children with overweight or obesity.

To conclude, the intervention performed in a real-life setting did not show an effect on zBMI in children with normal weight, but demonstrated a decreasing tendency in zBMI in children with overweight 12 months after the intervention, albeit statistically uncertain. The additional costs for the provision of CCHD and the training of health professionals in the model could be considered a cost-effective investment in the future health of children with overweight.

This thesis supports the view that children are capable of making health information meaningful and can take an active role in their health. It demonstrates the importance of a child-centred approach, respecting children as social actors in the context of their families and using tools that strengthen the child’s and the family’s health literacy.
Abbreviations

BMI     Body Mass Index
zBMI    BMI z-score, standardised BMI
CCC     Child-Centred Care
CCHD    Child-Centred Health Dialogue
CFQ     Child Feeding Questionnaire
CHC     Child Health Centre
CHP     Child Health Programme
CHS     Child Health Services
CNI     Care Need Index
HLQ     Healthy Lifestyle Questionnaire
ICER    Incremental Cost-Effectiveness Ratio
IOTF    International Obesity Task Force
MRC     Medical Research Council
NBHW    National Board of Health and Welfare
PSEPAD  Parental Self-efficacy for Promoting Healthy Physical Activity and Dietary Behaviours in Children Scale
RCT     Randomised Controlled Trial
RHB     Rikshandboken (The Swedish national handbook for CHS)
SOFT    Standardised Obesity Family Therapy
UNCRC   United Nations Convention on the Rights of the Child
WHO     World Health Organisation
Original papers


Related papers


Introduction

The complex public health problem of child obesity is rising globally and affecting most developed countries worldwide. Childhood obesity impacts on the child’s mental and physical health and well-being in both the short and the long term and is associated with increasing health care costs (Singh et al. 2008, Frew 2016, WHO 2016a, Evensen et al. 2017, Brown et al. 2019). Child overweight, which is a condition that might lead to childhood obesity, has been associated with weight stigmatisation and reduced mental health (Pont et al. 2017). The causes of overweight and obesity are multifaceted and to tackle the obesity epidemic it is important to understand the contextual factors as well as the risk and protective factors (Campbell 2016).

As children with obesity are likely to keep obesity in adulthood and are at risk of chronic illness, prevention strategies in early life are necessary (Brown 2019). Due to the complex nature of childhood obesity, interventions for the prevention of childhood obesity are particularly challenging. They need to be developed and evaluated based on published research evidence, suitable programme theories and the perspective of the stakeholders, understanding the context and real-world practice (Cathain et al. 2019, Smith, Fu et al. 2020).

Reviewing the overwhelming literature, this thesis addresses the importance of a multi-level design starting early in life, when the child is preschool aged and emphasising the role of the family as effective prevention strategies. It also introduces health promotion and the primary care setting as potential components for the prevention of obesity in preschool children. The perspectives of the children, parents, and health professionals and the description of the Swedish Child Health Services give essential information and form the basis together with the three theoretical frameworks – child-centred care, health literacy and perceived self-efficacy – for the development of an intervention for the prevention of obesity in preschool children in the Child Health Services.
Background

Child overweight and obesity in preschool children

Several studies have shown that childhood obesity predicts adult obesity. Preschool aged children, further described as preschool children, with obesity tend to maintain their obesity in adulthood (Singh et al. 2008, Evensen et al. 2017). Therefore, it is important to prevent obesity and promote a healthy lifestyle from an early age to reduce the likelihood of later obesity. Reviews suggest that the most effective efforts to prevent or reduce childhood obesity should reflect the complex aetiology of child obesity and focus on protective processes in the family (Waters et al. 2011, Nutbeam 2019, Carr and Epstein 2020).

Definitions and prevalence

Overweight and obesity are terms used to describe an excess of adiposity that presents a risk for health (Brown et al. 2019). Overweight is a condition that can develop into obesity and obesity is classified as a disease. A simple and widely used measure of adiposity is Body Mass Index (BMI), calculated as weight (kg) divided by the square of height (m). According to the World Health Organisation (WHO), overweight in adults is defined as BMI≥25 and obesity as BMI≥30 (WHO 1998). In children, specific BMI cut-offs are used, as BMI varies considerably with age, height, and to a certain degree with gender. There are several different definitions and references used to determine the child’s weight status, such as WHO references, CDC growth charts, and the most commonly used International Obesity Task Force (IOTF) standards, which makes it difficult to compare the prevalence of childhood overweight and obesity internationally (Brown et al. 2019).

The IOTF standards are derived from six pooled international data sets of height, weight, BMI, age, and gender for children 2–18 years of age and provide cut points by age and sex for overweight and obesity for children corresponding to the adult criteria BMI of 25 kg/m² for overweight (ISO-BMI 25) and 30 kg/m² for obesity (ISO-BMI 30) (Cole et al. 2000). Normal weight is defined as a BMI between ISO-BMI 25 and ISO-BMI 18.5 (Cole and Lobstein 2012).
In addition, to be able to compare results among growing children of different ages and over time, standardised BMI (BMI z-scores or zBMI) is used. zBMI is a measure of relative weight in children and is calculated based on weight, height, age, and sex, using a reference population aged between 2 and 18 years. In this thesis a Swedish reference population, born between 1973 and 1975, is used (Karlberg et al. 2003).

Prevalence

Over the past four decades, the global proportion of children with obesity has increased from 0.7 and 0.9% for girls and boys aged 5–19 respectively in 1975 to 5.6 and 7.8% in 2016 (Abarca-Gómez et al. 2017). The global number of children younger than 5 years with overweight or obesity has also increased from 32 million in 1990 to more than 41 million in 2016, mostly in middle-income countries (WHO 2017).

This rising trend seems to be levelling off, except for children in disadvantaged areas where parents have lower education and income levels. Among families with lower socioeconomic status in high-income countries, the prevalence of childhood obesity is still rising and socioeconomic-associated inequalities in preschool children are widening (Bann et al. 2017, WHO 2017, Bauman et al. 2019).

Also in Sweden, the prevalence of self-reported overweight in children aged 11–15 years increased from 7% to 15% between 1989 and 2018 and the prevalence of obesity increased even more, from 0.8% to 4% (Public Health Agency 2020). There is a similar pattern of stabilisation in 8–12-year-old children between 2003 and 2011, with a higher prevalence of obesity in schoolchildren from areas with lower socioeconomic standard (Sundblom et al. 2008), living in rural residential areas (Sjöberg et al. 2011) and where parents had lower levels of education (de Munter et al. 2016).

National data from the Swedish Child Health Service (CHS) showed a 9% overweight prevalence and a 2% prevalence for obesity among 4-year-old children born in 2014. The report noted significant regional differences within and between regions, which could not be explained by differences in socioeconomic conditions (Spong et al. 2021). The trend has been stable compared to a previous minor compilation of Swedish 4-year-old children, born between 2000 and 2004 (Bråbäck et al. 2009).

Consequences

Childhood obesity can be described as a disease that benefits from early diagnosis, prevention, and proper management to reduce escalation into significant medical and psychosocial problems and to minimise the societal and economic impact (Farpour-Lambert et al. 2015).
**Medical consequences**

Childhood obesity has shown to be an important predictor of morbidity and mortality in adulthood, although even before comorbidity is present, signs of endothelial dysfunction and cardiovascular risk factors can be detected (Baker et al. 2007). Children with obesity, depending on the severity and the duration, have an increased risk of type 2 diabetes, high blood pressure, high cholesterol, metabolic syndrome, asthma, polycystic ovarian syndrome, and non-alcoholic fatty liver disease (Pulgaron and Delamater 2014). Children with more severe obesity can develop obstructive sleep apnoea and musculoskeletal and joint dysfunction (Bass and Eneli 2015). Obesity is associated with increased all-cause mortality (Di Angelantonio et al. 2016) and an important contributing risk factor for cardiovascular diseases, cancer, and type 2 diabetes (Al-Goblan et al. 2014, Lauby-Secretan et al. 2016, Powell-Wiley et al. 2021).

**Psycho-social consequences**

Child obesity can have major effects on mental health and psychosocial development in children. Children with obesity have higher rates of low self-esteem and lower health-related quality of life in comparison to children with a normal weight, besides children with obesity with related physical health conditions, experience additional psychosocial distress (Small and Aplasca 2016). The spectrum of these psychosocial effects is wide, including risk of depression, disordered eating, anxiety, hyperactivity, body image disturbances, social stigma and weight-based victimization (Small and Aplasca 2016).

Weight-based stigmatisation may play an important role in the psychosocial consequences of overweight and obesity. Weight stigma refers to ‘the societal devaluation of a person because he or she has overweight or obesity’ (Pont et al. 2017, page 2). This often includes the unproven assumption that overweight and obesity stems from lacking control and self-discipline, which is inconsistent with current knowledge that body-weight regulation is not entirely under volitional control, but influenced by biological, genetic, and environmental factors (Rubino et al. 2020). It is commonly believed that parents are responsible for their child’s weight and that childhood obesity is a result of poor parenting (Gorlick et al. 2021).

A meta-analysis indicated that children aged 6–18 years with overweight or obesity were more likely to be bullied and that children with overweight were equally bullied as those with a BMI in the ‘obesity’ range (van Geel et al. 2014). Some studies suggest that weight stigma is already present in 32-month-old toddlers (Ruffman et al. 2016) and in 5-year-old children who already believe that overweight is a controllable condition (Musher-Eizenman et al. 2004). One study among 6-year-old children in 29 rural schools in the United States showed that those with severe obesity were rejected, made fun of, teased, picked on, and disliked (Harrist et al. 2016).
One notion is that weight stigma is tolerated in society because of the belief that stigma and shame will motivate people to lose weight (Callahan 2013). However, children who experience stigmatisation (weight-based teasing, bullying, victimisation) have been shown to increase their risk of augmented weight gain, binge eating, social isolation, avoidance of health care services, decreased physical activity, and decreased quality of life, which worsens obesity and creates additional barriers to healthy behaviour change (Pont et al. 2017, Palad et al. 2019). Sources of stigmatisation are many, including peers, parents, family, teachers, coaches, strangers, media, as well as healthcare professionals, which demonstrates that there is a need to treat individuals with overweight and obesity with respect and to disseminate current knowledge of obesity and body-weight regulation (Palad et al. 2019, Rubino et al. 2020).

Economic consequences

Obesity has also far-reaching economic effects on the individual families as well as on society at large, through direct costs within the health care sector, but also through indirect costs such as productivity losses for those who have obesity (Döring et al. 2016). A report from the Swedish Institute for Health Economics demonstrated that almost 4% of all deaths in Sweden in 2016 could be attributed to obesity-related illness. The estimated costs for obesity in the Swedish society was SEK 25.2 billion in 2016, while overweight costs SEK 23.4 billion (Andersson et al. 2018). Although short-term costs of childhood obesity may be relatively small, evidence suggests that obesity in childhood has a significant long-term burden if a life-time perspective is chosen with higher costs for higher levels of BMI, for both health-care expenditures and for productivity losses (WHO 2016a). These costs impose a large burden on the already pressured health care sector and economic evaluations on cost-effectiveness are needed to capture health and non-health costs and consequences (Brown, V et al. 2019, Zanganeh et al. 2019). Despite this fact, economic evaluations of interventions for the prevention of childhood obesity are still rare (Döring et al. 2016, Zanganeh et al. 2019).

The aetiology of childhood obesity in a contextual model

The aetiology of obesity is complex and involves a multilevel set of factors from several contexts that interact with each other, such as the genetic, biological, nutritional, psychosocial, behavioural, interpersonal, environmental, and cultural factors (Davison and Birch 2001). Previously, researchers have used the socio-ecological model to understand the multiple interactions and individual influences that put a child at risk of obesity (Davison and Birch 2001, Campbell 2016, Smith et al. 2020). The socio-ecological model, first developed as a conceptual model for understanding human development by Bronfenbrenner (1979), was later formalised as a theory-based framework for understanding multifaceted and interactive effects of personal and
environmental factors (Kilanowski 2017). Conceptualising the development of childhood obesity provides a better understanding of the many risk- and protective factors that impact health behaviours and outcomes. The conceptual model (Figure 1) can also be used for the development of effective, appropriately targeted prevention strategies in early life, improving health behaviours and routines (Townsend and Foster 2013, Campbell 2016, Smith et al. 2020).

![Figure 1. A contextual model for the multilevel set of factors that influence child health. Adapted from Davison and Birch, 2001 and reprinted with permission from the authors and 'Obesity Reviews'.](image)

Beginning in the inner circle, at the level of the child, the most direct determinant of children’s obesity is the imbalance between energy intake and energy expenditure, which is the result of numerous patterns such as diet, physical activity, sedentary behaviour, sleep and tooth brushing behaviours and preferences. These factors in interaction with child characteristics, such as the evident familial susceptibility, gender, and age of the child, can act as either risk factors or protective factors.

The next level highlights the importance of parents in shaping dietary and physical activity behaviours as well as family routines in young children. Parental diet, physical activity and sleep behaviours, preferences, feeding practices, and support in promoting
children’s healthy diet and physical activity are influenced by their knowledge, beliefs, health literacy, strengths, and resources, but also by the characteristics of the child (Davison and Birch 2001).

The subsequent level describes the socioeconomic factors, employment, working hours, leisure time, marital status, education, mobility, country of birth, societal stress and the environmental factors that contribute to the development of obesity or on the contrary to a healthy weight (Davison and Birch 2001, Campbell 2016). Food and physical activity at preschool, accessibility of fruit and vegetables, convenience food and restaurants, recreational facilities, child health services and neighbourhood safety are other important factors that influence the child’s weight (Davison and Birch 2001, Campbell 2016).

**Risk factors**

These are some of the most important risk factors that contribute to the development of obesity in preschool children.

*Parental weight, birth weight and rapid weight gain*

There is an increased likelihood for development of childhood obesity when the mother or father has obesity (Sørensen *et al.* 2016, Larqué *et al.* 2019) and even higher when both parents have obesity (Moraeus *et al.* 2012, Durmuş *et al.* 2013). Another strong risk factor is a higher birth weight (>4,000g) (Skilton *et al.* 2014, Ejlerskov *et al.* 2015, Geserick *et al.* 2018). Rapid growth during the first years of life is also seen as a significant risk factor for obesity in later life, both during the first two years of life (Woo Baidal *et al.* 2016, Zheng *et al.* 2018), and also when BMI accelerates between 2 and 5 years of age (Hughes *et al.* 2014, Geserick *et al.* 2018). This acceleration is called an early adiposity rebound, whereas ‘adiposity rebound’ is the phenomenon of a physiological rise in the child’s adiposity between the age of 5 and 8 years (Rolland-Cachera *et al.* 1984).

*Child lifestyle: dietary, physical activity and sleep behaviours*

It is widely accepted that higher total energy intake is associated with the development of obesity (Chi *et al.* 2017, Smith *et al.* 2020). There is strong evidence that higher intake of sugary drinks, including fruit juice in large quantities, and energy-dense food are risk factors (Pereira *et al.* 2005, Bleich and Vercammen 2018). Other dietary risk factors are low fruit and vegetable intake (Chi *et al.* 2017) and larger portion size (Hollands 2015). Four-year-old-children exposed to large portions had larger immediate intakes, but also a larger intake over time (Rolls *et al.* 2000, Orlet Fisher *et al.* 2003).
Both low physical activity, defined as low daily exercise and limited outdoor playtime, and sedentary behaviour, categorised as screen-based or non-screen-based behaviours (sitting, reclining or lying while awake), are associated with the development of childhood obesity in school children (Jiménez-Pavón et al. 2010, Duch et al. 2013, Chi et al. 2017, Wyszyńska et al. 2020). However, studies that demonstrate cause and effect relationships are limited (Robinson et al. 2017). Research suggested that children with more hours of screen time also consume fewer fruits and vegetables, and more sugary drinks and energy-dense food. Possible mechanisms are distracted eating, reduced feelings of satiety, and exposure to advertisements for energy-dense food (Robinson et al. 2017). Studies on the relation between sleep duration and the development of obesity showed that children with shortened sleep duration, ranging from 8–11 hours/night from infancy to school age, had increased risk of developing obesity (Taveras et al. 2014, Chi et al. 2017). Higher rates of screen time were also associated with reduced sleep duration (Hale and Guan 2015).

**Parental feeding practices and concerns about their child eating and overweight**

Parents influence child eating and weight status through specific behaviours in how parents respond to a child in feeding situations, defined as feeding practices, but also by concerns about the child’s eating and overweight (Ventura and Birch 2008, Ek et al. 2016). Restrictive feeding practices are strategies that parents employ to control what type of food or how much a child eats and have been associated with overeating, resulting in higher weight as this tends to override the child’s hunger and satiety signals (Melbye and Hansen 2015, Somaraki et al. 2020). Increased parental concerns about the child eating and overweight have been associated with lower levels of health-promoting practices and higher levels of restrictive feeding practices (Ek et al. 2016, Haines et al. 2018).

**Socioeconomic factors**

Low socioeconomic status is strongly associated with obesity in both adults and children (Mäki et al. 2014, Yang et al. 2019). In a study among 22 countries in Europe obesity was more common among people with socioeconomic inequalities (Mackenbach et al. 2008). Also, in the USA and Australia overweight was more prevalent among adults from socially disadvantaged backgrounds (King et al. 2006, Wang and Geng 2019).

The mechanisms underlying the relationship between socioeconomic status and child obesity are thought to be multifaceted and determined by different parameters (Homs et al. 2021). A systematic review that used Bronfenbrenner’s socio-ecological model (Figure 1) pointed out high screen time, poor food intake behaviours and birth weight, high parental high screen time, parental weight status, ethnicity and finally less attendance at preschool as potential mediators (Mech et al. 2016). Possible factors that interact with socioeconomic status and childhood obesity were low household income,
limited resources, low parental education, low health literacy, low occupational position, long maternal working hours, parental mental health, and stress factors, and lastly food advertising, marketing, and culture (Mech et al. 2016, Homs et al. 2021).

Studies from Australia, the UK and Canada showed socioeconomic differences from the age of 4 years and widening inequalities with increasing age (Oliver and Hayes 2008, Howe et al. 2011, Jansen et al. 2013). In Sweden the same pattern can be observed. Among 4-year-old children the social gradient between overweight and obesity is still unclear (Spong et al. 2021), but 6-year-old children with poorer socioeconomic conditions had overweight and obesity to a greater extent (Henriksson et al. 2016). Low education of either parent was strongly associated with more obesity in primary-school children (Lissner et al. 2016). These studies illustrate the need for interventions that reduce health inequalities at an early age (Marmot and Bell 2012).

**Protective factors**

Protective factors are aspects such as skills, strengths, or resources that help protect children from developing childhood obesity or enhance their ability to cope with the risk factors. A recent article that introduced central developmental processes as a new perspective to understand the aetiology of childhood obesity stated that more work is needed to identify protective strategies and study protective processes at the familial level to develop more effective interventions that reduce child obesity (Bohnert et al. 2020).

**Protective dietary and physical activity behaviours**

Studies suggest that higher consumption of fruit and vegetables in adults protects against weight gain and the development of obesity in adults (Mytton et al. 2014). The role of fruit and vegetable intake in the development of obesity in children is less clear (Barends et al. 2019). There is, however, evidence that diet behaviours adopted in childhood track throughout life, which implies that promoting fruit and vegetables at an early age reduces adult obesity (Birch and Ventura 2009, Brown et al. 2019). Strategies to promote vegetable intake in children aged 2–5 years include introducing vegetables though reinforcing parenting practices at an early age as part of a balanced and varied diet with adequate nutritious value, while providing parents with social support (Hendrie et al. 2017).

Increased physical activity through everyday activities, sports, and decreased sedentary activities (screen time) is protective against relative weight gains in childhood over time, even after controlling for genetic factors and childhood environment shown in a Finnish Twin Cohort study (Must and Tybor 2005, Jiménez-Pavón et al. 2010, Piirtola et al. 2017).
**Family routines**

A growing body of research describes the importance of structured home environments and social routines in favour of healthy diet, physical activity, and healthy sleep behaviours for children (Hart *et al.* 2020, Smith *et al.* 2020). Protective family routines such as shared family meals and sleep routines including routines for brushing teeth, that occur with predictable regularity supervised by an adult, have been suggested to be protective against excessive weight gain (Anderson and Whitaker 2010, Hammons and Fiese 2011, Jones and Fiese 2014) as they provide a sense of structure and offer the possibility to respond to the child and positively reinforce healthy behaviours (Fiese and Bost 2016). Structure-based feeding practices that parents can use to establish predictable food environments, while respecting the child’s autonomy, have been hypothesised to promote children’s self-regulatory skills and in this way create a healthy weight development, but more research is needed (Rollins *et al.* 2015, Ruggiero *et al.* 2021).

**Perceived parental self-efficacy**

To be able to promote a healthy diet and physical activity, parents must believe in their ability to promote these behaviours and feel confident to make changes in lifestyle that influence the child’s weight (Albanese *et al.* 2019). The idea of feeling capable is linked to Bandura’s concept of perceived self-efficacy which is further described in the theoretical framework of this thesis. Parental self-efficacy has been suggested as a protective factor that can help prevent childhood obesity (Alulis and Grabowski 2017, Enright *et al.* 2020).

**Prevention of childhood obesity in preschool children**

Prevention of childhood obesity is believed to be effective when started in preschool children or even earlier (Waters *et al.* 2011). Obesity prevention can be divided into primary and secondary prevention and aims to minimise the burden of disease and associated risk factors (WHO EMRO 2021) Primary prevention of obesity comprises interventions that target the entire population and aim to prevent the development of overweight as a risk factor for obesity and includes surveillance of the child’s weight development and identification of risk factors. Secondary prevention focuses on the early detection and screening for overweight and includes evidence-based management of children with overweight to prevent obesity. Strictly, secondary prevention also includes treatment of children that already have obesity to prevent long-term disease progression and development of comorbidities, but these efforts are not included in this thesis. This thesis highlights strategies that are suggested to be successful in the
prevention of childhood obesity in preschool children. It also describes the perspectives of important stakeholders: children, parents, and health professionals.

**Important components for an effective prevention intervention**

Developing a prevention strategy requires an understanding of the complexity of childhood obesity as well as the comprehension of the best available and most useable evidence on what works in a particular context (Nutbeam 2019). Multiple systematic reviews and original studies have identified components with the potential to prevent obesity and achieve long-term sustainable impacts (Waters *et al.* 2011).

*Start early in life*

Effective interventions need to begin in the early years of life, a time that is critical for shaping lifestyle behaviours (Brown *et al.* 2019, Landgren *et al.* 2020). Children’s tendency to learn can be used by parents, when aware of the impact of their own practices, to promote or support the development of healthy behaviours (Birch and Ventura 2009). Small sustainable changes in lifestyle could reap long-term health benefits beyond the promotion of a healthy weight (Brown *et al.* 2019).

*Multicomponent*

There is moderate-certainty evidence that multi-component prevention interventions, addressing both physical activity and diet, are most effective in reducing BMI in children 0–5 years (Colquitt *et al.* 2016, Brown *et al.* 2019). As childhood obesity and poor oral health share many common risk factors (de Jong-Lenters *et al.* 2019) it is advocated to include oral health behaviours and the promotion of tooth brushing routines in obesity prevention programmes (Dooley *et al.* 2017). As tooth brushing in children is embedded in complex daily habits and needs the active involvement of parents, tooth brushing can be considered a family routine that is protective if established (de Jong 2019). Enhancing routine sleep behaviours resulting in longer duration of sleep, and also greater stability in sleep, is another strategy that has demonstrated positive effects on weight regulation (Anderson and Whitaker 2010, Miller *et al.* 2014, Miller *et al.* 2015, Hart *et al.* 2020).

*Family-based*

Family involvement is frequently stated as a crucial component, targeting parents as role models or ‘agents of change’ (Edvardsson *et al.* 2011, Ling *et al.* 2016, page 1, Matwiejczyk *et al.* 2018). Strategies demonstrated to be effective against child obesity often focus on a strengths-based approach empowering parents to actively change the child’s lifestyle (Small and Aplasca 2016, Landgren *et al.* 2020). In family-based interventions the perspective has to shift from an individual level concept to a more
relational understanding of health embedded in the social-ecological model (Small and Aplasca 2016). An evidence-based treatment model for childhood obesity that focuses on the fact that relationships are central to health and behavioural change is the Standardised Obesity Family Therapy (SOFT). SOFT is based on systemic theory and has shown positive effects regarding the degree of obesity, physical fitness, self-esteem, and family functioning (Nowicka et al. 2007). It has specifically been developed to use family resources and family interactions for the implementation of lifestyle changes and engage the family in positive behaviour support strategies (Nowicka and Flodmark 2011). Research about therapeutic communication recommends engaging children and families as partners, encouraging dialogue where both children and parents fully contribute (McPherson et al. 2017).

Focus on health promotion

Interventions seem to be more effective when they do not solely focus on weight and unhealthy behaviours, but rather emphasise health and the development of healthy behaviours within the entire family (APA 2020, Small and Aplasca 2016). There is evidence that healthy behaviours do not automatically develop when unhealthy behaviours are reduced but require positive reinforcement of new behaviours (Carr and Epstein 2020, Puhl et al. 2020). Public health media messages for instance are perceived as motivating when they are positively formulated and focus on making healthy behavioural changes (Puhl et al. 2013).

Health promotion and obesity prevention are linked efforts that in practice share many goals, but on the conceptual level, obesity prevention focuses primarily on the identification of risk factors, early detection, and treatment, while health promotion emphasises efforts that identify protective factors and strengthen people’s health, well-being, and quality of life (Tengland 2010). The overarching aim of health promotion is to empower people, including the more vulnerable groups, and provide them with tools to gain control over their health and its determinants (WHO 1998). Empowerment is the social and reflective process in which people become conscious of their knowledge and understanding and in this way develop social and health skills that improve health (Poskiparta et al. 2001).

Promotion-focused strategies seem to increase healthy diet, especially when parents provide a home food environment with a variety of health options so that children can choose freely and develop preferences for healthy behaviours (Melbye and Hansen 2015, Carr and Epstein 2020). Promoting good nutrition, sufficient physical activity, healthy teeth, and quality sleep in young children and supporting already established protective factors within the family system could help prevent childhood obesity and associated diseases later in life (WHO 2018, WHO 2019), especially, if a more participatory approach was used to be able to explore and intervene in psychosocial factors within the family (Bohman et al. 2013).
Primary health care providers

Interventions need to be developed in a real-world setting in ongoing practice so that they have the potential to be implemented and maintained long-term and use already existing resources to be more cost-effective (Waters et al. 2011, Small and Aplasca 2016). Primary care is viewed as an ideal real-world environment for primary prevention programmes, because of the unique accessibility (Brown et al. 2015, Smith et al. 2020). Interventions in children aged 2–5 years were suggested to be effective when parents were engaged in interactive education integrating techniques of behavioural therapy or motivational interviewing (Brown et al. 2015, Ling et al. 2016). Primary health care providers could provide tailored guidance according to personal needs of the families as they already have knowledge of the family and a long-term trusting relationship (Brown et al. 2015, McPherson et al. 2017).

To be able to open a non-judgemental conversation about obesity, health professionals require adequate and recurring training to gain confidence in assessing and communicating about weight-related issues with families, but also age-appropriate tools for promoting a healthy lifestyle (Ling et al. 2016, Sutaria and Saxena 2019, Uy et al. 2019). Because primary health care providers see the same children and their families on a regular basis, often from birth, there is a need for the development and evaluation of low-intensive communication models that can guide conversations within the context of a routine primary care visit (Sim et al. 2016, Enö Persson et al. 2018, Uy et al. 2019). Such a communication model should use a staged approach, be interactive and family-based, and include visual material with a focus on overall health, not weight (Brown et al. 2015, Ling et al. 2016, Uy et al. 2019).

The child’s perspective

When developing interventions for the prevention of obesity it is important to know the children’s perceptions of obesity, weight, and health. When children aged 5–12 across ethnic groups were asked for their views about body size and weight, they emphasised the importance of friendship, support, and social inclusion (Rees et al. 2011, Mériaux et al. 2010, Derwig 2014, Murphy et al. 2021). As children believed that body size is a controllable condition and attributed negative characteristics to overweight people, it is important to modify these beliefs in children, parents, and the community at large (Rees et al. 2011, Murphy et al. 2021). Ten-year-old children experienced negative emotions or disbelief when they were told that they had overweight and felt they lacked information about what they could do about it (Nnyanzi 2016). Children with overweight aged 8–13 who participated in a health course revealed that they felt they had to act here and now in order not to develop obesity and become ‘like one of them’ (From 2019, page 827). They experienced a significant sense of agency and competence as the course allowed them to develop
strategies to cope with the challenges to improve health behaviours in their everyday lives (From 2019). This illustrates how important it is to understand how children understand health messages and to recognise them as social and competent agents (Wiseman et al. 2018). In line with the UN Convention on the Rights of the Child UNCRC (UNICEF 1989), children have the right to express their views on how they experience matters that concern them, but so far studies that explore the experiences of 4-year-old children who participate in an intervention that aims to prevent childhood obesity are lacking.

The perspective of parents

How to best support parents in obesity prevention and health-promoting activities requires the knowledge of parents’ experiences of and preferences for communication about their child’s health and weight.

Parents’ experiences involved feelings of anxiety, blame, embarrassment, shame, and ambivalence in weight-related communication with health care providers (Goodell et al. 2008, Gorlick et al. 2021). Parents felt questioned and sensed that health care providers they had known for many years assumed they had unhealthy behaviours, while parents considered themselves as positive role models, encouraging and well-informed about the benefits and disadvantages of various behaviours for their child’s health (Goodell et al. 2008, Stenhammar et al. 2012, Moberg et al. 2021). Some parents mistrusted the impersonal collective reference growth charts used by healthcare professionals to identify a healthy weight and described the importance of seeing the child as a unique person (Goodell et al. 2008). Others felt that these were useful tools but wanted a visual and easily understood explanation to be able to interpret the results (Ames et al. 2020).

Parents felt responsible for promoting the child’s health, but wanted professional support from CHS and preschool and a collective responsibility from the community (Stenhammar et al. 2012). They wanted health professionals to be competent with good communication skills and to supply them with tailored, step-by-step, interactive and visual information (Uy et al. 2019, Ames et al. 2020). Parents wanted support to be proactive, early, frequent, honest, and straightforward, but non-judgemental (Ames et al. 2020). Support should be based on the exploration of the context of the family understanding, the influence of everyday life stress, the temperament of the child, previous experiences of overweight and already used strategies as well as the availability of additional support of extended family, friends, preschool, and society at large (Edvardsson et al. 2011, Schalkwijk et al. 2015, Ames et al. 2020). Parents desired a respectful, sensitive, and positive approach motivated by genuine interest and concern for the child’s health and well-being and wanted to be recognised as experts on their own child and their behaviours (McPherson et al. 2017, Uy et al. 2019,
Ames et al. 2020, Gorlick et al. 2021). They also wished for guidance in how to communicate with their children about weight and concern for their future health in order not to trigger low self-esteem or eating disorders (Ames et al. 2020).

The perspective of health professionals

In Sweden and elsewhere, nurses play an important role in promoting health and are often in the prime position addressing overweight in children. A study within the Swedish CHS showed that nurses paid little attention to health behaviours in dialogues between nurses and parents (Bohman et al. 2013). One of the suggested explanations was that nurses did not feel confident motivating families to gain control over their health behaviours as dietary and physical activity behaviours within the family were considered delicate topics, especially in families with social challenges such as low income, unemployment, and separation (Bohman et al. 2013, Ljungkrona-Falk et al. 2014). A qualitative meta-synthesis reported that health professionals felt they lacked knowledge of the underlying factors of childhood obesity and felt unsure of how to approach and discuss weight-related health with children and their parents (Bradbury et al. 2018). Furthermore, they did not feel confident in their ability to engage parents to change their family’s lifestyles as they often had experienced emotional parent reactions when discussing child weight (Bradbury et al. 2018, Sjunnestrand et al. 2019, Uy et al. 2019). They wished for appropriate training with room for reflecting on their personal experiences and with special focus on how to raise the issue in the presence of the child, as they feared harming the child due to the existing stigma of childhood obesity (Bradbury et al. 2018, Sjunnestrand et al. 2019).

Nurses also felt that they had limited time for discussions with parents about their child’s weight development, which could be facilitated by strategically structured health dialogues and follow-up (Sjunnestrand et al. 2019). They wished for appropriate health promotion materials and objective tools, such as the BMI growth chart, to be able to focus on healthy behaviours instead of focusing on the child’s weight. They felt that building a good and trustful relationship with all members of the family and matching the dialogue to the family’s stage of change could prevent emotional reactions in parents when the topic of overweight was brought up (Bradbury et al. 2018, Sjunnestrand et al. 2019). Nurses wanted continuous practice, constructive feedback, encouragement, and professional guidance in their assignment to support children and families towards a healthy lifestyle (Uy et al. 2019, Westergren et al. 2021).
Child Health Services

Child Health Services (CHS) during early childhood have great potential to serve as an arena for health promotion and health surveillance. CHS reaches the full population with regular contacts with children and their families over time (Oberklaid and Drever 2011, Messito et al. 2020).

The Swedish CHS are voluntary, free of charge and attended by nearly all children from birth up to the age of six and their families, irrespective of social position or ethnicity (Wallby and Hjern 2011). The Swedish CHS, guided by the national Child Health Programme (CHP), aims to promote children’s physical, psychological, and social health and development, to prevent illness, to detect emerging problems early, and to intervene when needed (NBHW 2014).

The Swedish Child Health Programme

The Swedish CHP provides stepwise health services based on the need of the children and their families. CHP is guided by the notion that children’s health and development is influenced by a range of individual, social, economic, and environmental factors known as determinants of health that may be protective or threatening (NBHW 2014) and by the UNCRC that puts the child’s best interests and rights in focus (UNICEF 1989). Health professionals use person-centred care, adapting each health visit to the specific family’s situation and needs.

CHP is divided into three steps. The important first step consists of 18 scheduled universal health visits from birth to the age of six, 14 with the nurse and four with the nurse and physician together. These visits are offered to all children and include a health dialogue with the child and his or her parents, observing the health determinants that protect or threaten the health of the child. The health professionals also conduct observations and targeted investigations, surveillance of the child’s health and development over time and provide health-related guidance relevant to the child’s age and the family’s needs. The first step also includes home visits, parental support groups and immunisations (NBHW 2014).

The universal 60-minute 4-year health visit is an example of the visits within the first step of the CHP. This visit consists of several activities such as a health dialogue with the parents on the child’s health and development, surveillance of hearing, sight, speech, and communication as well as monitoring height, weight, and BMI (RHB, 2021a).

The second and third step of the programme include additional interventions or support to children and families according to need and involve collaboration with other
primary care providers, social service workers, or referrals to specialist care such as psychologists, speech therapists and dieticians (RHB 2021b). Overweight is a condition that par excellence could be managed in the second step, but evidence-based models that can be used in CHS for the management of overweight and prevention of obesity are lacking. Children with obesity, however, fit in the third step and should be referred to a specialist obesity team outside the primary care setting as effective treatment for children with obesity aged 2–18 requires a family-based multicomponent intervention with at least 26 contact hours (APA 2020).

**Organisation**

The CHP is provided at child health centres (CHC) that are privately or publicly organised within the primary care setting. CHS nurses, who are specialists in either primary healthcare or paediatric care work in a team with physicians, specialised in general practice or paediatrics and psychologists. The CHS are regulated on a regional basis, but the content of the CHP is guided by the recommendations of the National Board of Health and Welfare (NBHW 2014). These recommendations have been transformed to web-based quality-assured guidelines, *Rikshandboken*, (RHB) to provide CHS professionals in all Swedish regions with knowledge and methodological support contributing to a high quality CHS (RHB 2021c).

**Care Need Index**

In Skåne, a region in the southern part of Sweden, all CHCs are publicly financed, and resources are allocated according to the Care Need Index (CNI). CNI is a socioeconomic need index which can be used to measure health needs based on the socioeconomic conditions and in this way allocate resources within the health care system. The index value is 1 and higher values receive more funding as they are related to increased risk of ill health and illness (Sundquist *et al.* 2003). Regarding CHS, each CHC receives a CNI rate based on sociodemographic information on parents listed at the CHC: unemployment, low educational status, single status, children under age 5, high mobility (moved house during the last year) and born outside Europe.

**CHS nurses**

In the Swedish CHS specialist nurses are the primary CHS providers for the child and his or her family. They are trained in children’s health and development, children’s rights, and living conditions and need to have knowledge of the national CHP and current methods (NBHW 2014). They are educated in ways to promote health, prevent
ill health, and detect illness in an early stage, but also require pedagogical competence to be able to provide guidance to children and their families and to lead parent groups (Swedish Society of Nursing 2017). To be able to promote health they are taught the holistic view on health and salutogenesis, which focuses on strengths and resources and promotes ‘protective e.g. salutary’ factors in order to maintain and strengthen health (NBHW 2014). The salutogenic approach acknowledges the active role of people in creating health and thereby improving health and bringing about change and recognises that health arises from interplay between people and their context (Eriksson and Lindström 2008). CHS nurses need support of uniform guidelines and the wider community to be able execute health promotion strategies and help children and parents to safely navigate the temptations of our modern society (Stenhammar et al. 2012). They also need guidelines for the management of preschool children with overweight, because without guidelines management varies. Some offer excessive extra visits for continuous observations of the child’s diet, physical activity and weight, while others do not identify overweight at all (Isma et al. 2013).

Theoretical framework

In this thesis three theoretical frameworks have been applied to provide support for the intervention and to understand the process of change.

Child-Centred Care

One of the frameworks for the intervention is Child-Centred Care (CCC) wherein the child’s perspective and preferences are at the centre of thinking and practice (Coyne et al. 2016). In CCC, children are seen as active participants in their own health care, with recognition of their rights, needs, and competencies (Coyne et al. 2016). The framework nevertheless emphasises that the child cannot be understood in isolation from its family, but rather as a key actor within the family where all members have roles to play and rules to respect (Coyne et al. 2016).

Part of CCC is that children receive not only age-appropriate information, attendance and response, but also participate actively to be able to share experiences, and voice their views, opinions, needs, preferences, and choices (Sommer et al. 2009, Coyne et al. 2016). Active participation ensures that children’s rights are upheld and is a fundamental component in health promotion, characterised by the involvement of children as active partners, feeling trust and taking control, enhancing the understanding of their own needs and desires (DeWalt and Hink 2009, Söderbäck 2010). Children as young as 2 years old can communicate their opinions on
health and needs in health care settings (Nova et al. 2005, Stålberg et al. 2016). They generally prefer to be included in health care interactions, but active participation depends on the attitudes of health professionals as well as their parents (Coyne and Gallagher 2011, Coyne and Harder 2011). To be able to actively involve children and elicit the child’s perspective, health care providers should follow the child’s initiatives and encourage the child by reflecting and discussing their views and preferences and confirming their insights (Kangas 2016).

**Health literacy**

The framework of health literacy captures how individuals process, understand, and interact with health messages to shape attitudes and behaviours that promote and maintain good health (Velardo and Drummond 2016, Ringsberg et al. 2020). Health literacy in general can be classified in three dimensions. The first dimension is defined as fundamental literacy and comprises the basic skills and ability to access and understand health messages in everyday situations. The second dimension, interactive literacy, refers to more advanced cognitive skills in evaluating health information and deriving meaning from different forms of communication in changing situations. The last and highest level is critical literacy, which is the ability to apply and critically analyse health information as well as to gain greater control over everyday situations and life events (Nutbeam 2000). People with better developed health literacy have the competence and skills that enable them to engage in health-enhancing activities and behaviours (Nutbeam 2017).

As health literacy helps to make healthy choices it preferably should be addressed from an early age and endure into adulthood (Borzekowski 2009, Velardo and Drummond 2016). To increase a child’s health literacy, health messages should be communicated in ways that promote interaction and active participation, such as using open-ended questions and easy-to-understand language as well using supportive age-appropriate illustrations (Nutbeam 2000, Trollvik et al. 2011, Fairbrother et al. 2016). Studies show that children can interpret health message and derive meaning within their own unique social worlds, reflecting upon their own understandings and experiences (Fairbrother et al. 2016, Wiseman et al. 2018). Health literacy skills can be improved when adults convey health messages around a narrative story using pictures (Freeman 2015, Stålberg et al. 2016).

**Perceived parental self-efficacy**

Perceived self-efficacy has been introduced by Bandura (1997) as part of the social cognitive theory which views human functioning as a dynamic process where personal factors interact with behaviours and the environment. Perceived self-efficacy can be
defined as a person’s belief in his or her own ability to perform a given activity in a certain situation (Bandura 1997). In health promotion this would be the belief in the ability to promote a healthy lifestyle and the awareness of how lifestyle habits affect health (Bandura 1998). Unless individuals believe they can achieve desired outcomes by their actions, they have little incentive to act (Bandura 1998). Individuals’ beliefs about their efficacy determine whether they will make use of their knowledge, skills, and resources to be able to exercise control over their motivation, affect, and behaviour (Bandura 1998). Perceived self-efficacy is formed with respect to a specific area, as one can have high self-efficacy in one area but low self-efficacy in another (Holloway et al. 2016).

This thesis focuses on perceived parental self-efficacy in promoting a healthy lifestyle, which can be defined as the expectation of a parent about their ability to successfully promote healthy lifestyle in their children (Jones and Prinz 2005). Parents with higher confidence in their efficacy are more likely than those with lower self-efficacy to promote a healthy lifestyle in their children when facing challenging situations (Jones and Prinz 2005). There is evidence that higher perceived parental self-efficacy in promoting diet has been associated with improved child diet, while studies demonstrated a higher efficacy in promoting physical activity and improved child activity levels as well as an inverse relationship between higher self-efficacy and lower child weight (Woods and Nies 2019). There is also some evidence that self-efficacy in both mothers and fathers with young children aged 0–5 years reduces over time as children grow older (Campbell et al. 2010, Walsh et al. 2019). One way of strengthening perceived parental self-efficacy is through counselling or health education, especially when given by a trusted, credible person or source (Resnick 2018). The relationship between parental self-efficacy and parental health literacy has not been well studied, but one study performed in parents of new-borns suggested that lower parental health literacy was associated with lower parental self-efficacy (Fong et al. 2018).
Rationale

Preschool children with obesity tend to maintain obesity in adulthood, which indicates the need for early prevention (Brown et al. 2019). As evidence-based programmes that can be used in CHS are lacking, there is a need for the development of a low-intensive multicomponent child-centred health promotion model that is feasible and effective in preventing obesity in preschool children (Sim et al. 2016, Enö Persson et al. 2018, Uy et al. 2019, Smith et al. 2020). The model should engage all family members and reflect the underlying complexity of child obesity with focus on health promotion and protective processes in the family. A low-intensive intervention with a step-by-step structure could facilitate future implementation in the real world.

As children have the rights to actively participate in health promotion and prevention activities and want to participate from an early age, the intervention should be child-centred, regarding the child in the context of the family (UNICEF 1989, Swedish Government 2018, Coyne et al. 2016). Parents feel responsible for promoting their child’s health and want to be supported by competent health professionals with sensitive and non-judgemental communication skills and age-appropriate, interactive, objective, and visual health promotion material (Stenhammar et al. 2012, Ames et al. 2020).

Swedish CHS provide health promotion and prevention activities to nearly all families, regardless of their socioeconomic status (NBHW 2014). CHS nurses are well positioned to provide a theory-based structured dialogue and equipped to empower children and parents. They can support families where the child is identified with overweight or obesity, when adequately trained and endorsed with recurrent reflective supervision. (Severinson and Borgenhammar 1997, Whitehead et al. 2021).

The intervention should not only be assessed for effectiveness, but also include assessments of possible mechanisms for the process of change, impact on health inequalities, potential adverse events, costs and elucidate the experiences of important stakeholders, children, parents, and health professionals to enable well-informed decisions about the potential implementation in the future (Moore et al. 2015).
Aims

The overall aim of this project was to develop an evidence-based child-centred multicomponent model that can be used within the Child Health Services and aims to promote a healthy lifestyle in families and prevent obesity in preschool children.

The thesis is based on four papers, each with its specific aim

– to test a Child-Centred Health Dialogue model for primary prevention of obesity for 4-year-old children in Child Health Services, for its feasibility and the responsiveness of its outcomes (Paper I)

– to evaluate the effects and cost-effectiveness of a Child-Centred Health Dialogue in the Child Health Services in Sweden on 4-year-old children with normal weight and overweight (Paper II)

– to explore children’s experiences of a Child-Centred Health Dialogue at the 4-year health visit in the Child Health Services and capture the child’s perspective (Paper III)

– to evaluate the changes in perceived parental self-efficacy and its moderating effect on child weight after a Child-Centred Health Dialogue for the primary prevention of obesity (Paper IV)
Methods

Design

This thesis contains two studies: Study A and Study B (Table 1).

Study A was designed as a feasibility study with a quasi-experimental cluster design comparing children that received the intervention with a register control group, matched on CNI and rural location (Paper I).

Study B was a cluster Randomised Controlled Trial (RCT) that compared usual care with intervention care and followed the CONSORT recommendations for RCTs and the CHEERS guidelines for economic evaluations (Consort 2010, Husereau et al. 2013) (Paper II, Paper IV). Part of Study B was a qualitative study with an inductive descriptive approach (Paper III). The RCT was registered at ClinicalTrials.gov (2016721LUC3) in February 2020.

Table 1. Overview of the studies presented in this thesis

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<th>Paper</th>
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<th>Sample</th>
<th>Data collection</th>
<th>Analyses</th>
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<td>A</td>
<td>I</td>
<td>quasi-experimental cluster</td>
<td>- 785 children</td>
<td>- prospective reports</td>
<td>- two sample t-test</td>
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<td>- electronic medical records</td>
<td>- Fisher’s exact test</td>
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<tr>
<td>B</td>
<td>II</td>
<td>cluster-RCT</td>
<td>- 35 CHC - 92 nurses - 6,047 children</td>
<td>- electronic medical records</td>
<td>- linear mixed regression model</td>
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<td>- healthcare pricelist</td>
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<td>- questionnaires</td>
<td>- incremental cost-effectiveness ratio</td>
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<tr>
<td>B</td>
<td>III</td>
<td>inductive descriptive</td>
<td>- 21 children in the presence of a parent</td>
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<td>- qualitative latent content analysis</td>
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<tr>
<td>B</td>
<td>IV</td>
<td>cluster-RCT</td>
<td>- 1,197 children - 1,115 mothers - 869 fathers</td>
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The research followed the methodological framework of the UK Medical Research Council (MRC) for the development and evaluation of complex interventions. The methodological framework provides structural guidance to prevent implementation failure and has been updated recently (Craig et al. 2013, Skivington et al. 2021).

The methodological framework

The MRC framework helped to systematically develop a complex intervention that promotes health behaviours and prevents obesity in preschool children using the best available evidence and appropriate theory (Skivington et al. 2021). A complex intervention has been described as an intervention that involves multiple interacting components and complex behaviours for those delivering or receiving the intervention, targets various groups, has several outcomes and can be tailored during the research process (Craig et al. 2013). The MRC framework contains of four phases: development, feasibility/piloting, evaluation, and implementation (Figure 2).

![Figure 2. The MRC framework (adapted from Craig 2013)](image)

The development of the intervention, the Child-Centred Health Dialogue (CCHD) was based on the exploration of the problem, the possible causes and the need for the intervention (Landgren et al. 2020) and is described under the heading ‘Intervention care’. To understand the mechanisms by which the intervention is supposed to work and how they influenced the desired outcomes, the MRC guidelines suggested
designing a logic model based on reviewed research evidence and existing theories (Cathain et al. 2019). The logic model for CCHD described the approach (inputs), the intervention and participants (outputs) and proposed short, medium, and long-term outcomes (Paper I, Figure 1). The logic model also helped to consider the available funding and resources.

Following the MRC framework, the intervention was then tested for feasibility, including assessing the procedures, examining stakeholders’ acceptability, estimating recruitment and retention rates, determining sample size and the responsiveness of the outcomes (Giangregorio and Thabane 2015). The feasibility phase was important for understanding the context in which the intervention took place, identifying facilitators or barriers for future use of the intervention in real-life contexts (Craig et al. 2013). During this phase the author of this thesis and the project leaders were in close contact with those who delivered and received the intervention, exploring the experiences of parents and nurses (Håkansson 2015, Håkansson et al. 2019) and those who paid for the health services and the policymakers (Cathain et al. 2019, Region Skåne 2016).

The evaluation phase consisted of an assessment of effectiveness and cost-effectiveness as well as a process evaluation (Moore et al. 2015). To prevent selection bias the design was a RCT including the evaluation of potential unintended harms (Cathain et al. 2019). The process evaluation aimed to capture fidelity (whether the intervention was delivered as intended) and to understand the process of change (Moore et al. 2015). Exploring the mechanisms by which the delivered intervention produced change is crucial in understanding the intervention effect, especially when the intervention is being replicated (Moore et al. 2015). Complex interventions usually undergo some changes when implemented in different contexts. Understanding what was delivered in practice could provide the research team, practitioners, and policymakers with important information about how the intervention might be implemented on a larger scale (Moore et al. 2015). The preparation of the implementation has been part of the development, feasibility, and evaluation phase, so that the intervention can be implemented maintaining its key functions in larger real-world settings (Skivington et al. 2021).

The research process was dynamic, moving backwards and forwards between the development, feasibility, and evaluation phase and involved both quantitative and qualitative research methods (Cathain et al. 2019).

**Participants**

The study population, 4-year-old children and their parents, were registered at CHCs eligible for the studies and received care from a CHS nurse.
**Children**

In Study A inclusion criteria for the intervention group were children born between May 2011 and May 2012 that participated in the 4-year health visit. They were compared to a register control group of children, born between January 2011 and May 2012 that participated in their 5-year-health visit (Paper I).

The inclusion criteria in Study B (Paper II) were children born between January 2013 and August 2014 who participated in the 4-year health visit.

Inclusion criteria of the qualitative part of Study B were 4-year-old children with sufficient skills in Swedish or English who took part in the 4-year health visit (Paper III).

**Parents**

In Study B inclusion criteria were parents of the abovementioned children registered at CHCs included in Study B with sufficient skills in reading and writing Swedish (Paper IV, Thesis).

**Child health centres**

In Study A intervention care was executed at 3 CHCs and matched with 8 CHCs according to CNI and residential area that executed usual care.

In Study B there were 63 CHCs found eligible for the study of which 47 CHCs were situated in two cities with a mean prevalence of overweight of 7.6% and an additional number of 16 CHCs in seven municipalities with a prevalence of overweight of at least 9%. Before stratification and randomisation, 37 CHCs, 27 of them in cities and 10 in smaller communities, agreed to participate, while 26 CHCs declined, because of time constraints. The CHCs that declined were comparable in mean prevalence of overweight (7.8% and 8.6% respectively) and mean CNI (1.1 in both) to the CHCs that accepted participation.

Figure 3 presents the map with all CHCs included in Study A and Study B.

**Nurses**

In Study A there were 19 CHS nurses who participated in the study, 6 nurses executed intervention care, while the other nurses performed the usual 4-year health visit.

Study B included 92 nurses of whom 43 worked at 18 CHCs allocated to usual care, while 49 nurses worked at 17 CHCs allocated to intervention care and were trained in the intervention.
Figure 3. The location of participating CHCs in Study A and B

Study setting

The research took place in Skåne, a region in the southern part of Sweden consisting of larger cities and smaller municipalities and a population of around 1,300,000. In 2015, approximately 100,000 children aged 0–6 years were registered in the region at 146 CHCs, employing more than 350 CHS nurses (Region Skåne 2016). In Skåne, parents have the possibility to choose the CHC they like to visit and receive equal CHS, free of charge and according to CHP, irrespective of private or public ownership of the centre. In 2015, the mean CNI for all CHC in Skåne was 0.93, varying between 0.32 and 2.60. CHCs with a CNI≥0.93 were defined as CHCs in an area with lower socioeconomic status, while CHCs with a CNI<0.93 had a registered population with a higher socioeconomic status.
The prevalence of overweight and obesity is unevenly distributed in Skåne. In 2014, 9.2% of all 4-year-old children born in 2010 had overweight and 2.0% had obesity with a distribution between all municipalities in Skåne of 6.5% to 19.5% for children with either overweight or obesity (Region Skåne 2015). In 2015 the prevalence of overweight and obesity among 4-year-olds born in 2011 was 9.9% and 2.3%, respectively (Region Skåne 2016).

**Usual care**

Usual care involved a 4-year health visit according to the Swedish CHP. The 4-year health visit included a health dialogue and identification of overweight using the IOTF definitions. The nurses working in the Swedish CHS were guided in their work by the digital national handbook for CHS (RHB 2021a).

As part of Study A, a questionnaire was distributed to all 351 nurses working at the 146 CHCs in Skåne to describe usual care before the start of Study B in May 2016 (Paper I). The questionnaire was answered by 229 nurses (65%) and showed that 55% of the responders did not perform a structured health dialogue at the 4-year health visit and that 77% experienced difficulties discussing diet and 93% communicating about overweight. Nurses did show the BMI growth chart during the visit, 45% always and 24% often, but only 10% used illustrations to promote a healthy lifestyle.

The questionnaire was also used to describe the management of children identified with overweight at the eligible CHCs for Study B before their recruitment in May 2016. Of the 173 nurses working at the 63 eligible CHCs 156 nurses (91%) offered families, where the child was identified with overweight an extra visit: 55% offered one extra visit 3–6 months after the visit and 12% two extra visits. Regarding referrals to a dietician or to a specialised overweight team 76 nurses (44%) responded that they always and 72 nurses (42%) that they sometimes referred children identified with overweight.

Regional guidelines adopted in February 2014 stated that children identified with obesity should be referred for treatment to a multidisciplinary obesity team (specialised nurse, dietician, and paediatrician) for treatment outside the primary care setting (Region Skåne 2014).

**Intervention care**

Intervention care was developed as a low-intensive structured child-centred dialogue by professionals in CHS, including the author of this thesis and guided by the MRC framework. The development was based on the best available evidence and theoretical concepts of CCC, health literacy, and parental self-efficacy.
The Swedish name for CCHD is ‘Grunda Sunda Vanor’, which means ‘building healthy habits’. CCHD follows the structure of the Swedish CHP (RHB 2021b) and consists of two parts (Figure 4):

– a universal part, offered to all 4-year-olds regardless of their weight and their parents at their 4-year health visit.

– a targeted part, called Family Guidance, for families where the 4-year-old has been identified with overweight or obesity.

**Swedish Child Health Programme**

<table>
<thead>
<tr>
<th>To all</th>
<th>To all in need of extra support</th>
</tr>
</thead>
</table>
| • Promote health  
• Prevent ill health | • Additional support on needs basis  
• Collaboration with other health care givers |
| CCHD  
• Part one  
• All children  
10-minute structured dialogue on healthy diet, physical activity, family routines  
Identification weight status | CCHD  
• Part two  
• Children with overweight or obesity  
45-minute Family Guidance identifying protective factors or small changes in lifestyle | Referral  
• Children with obesity  
• Children with overweight on request  
Referral to specialist care for children with obesity and overweight |

*Figure 4. CCHD integrated in the three steps of the Swedish CHP (RHB 2021b)*

CCHD is based on a salutogenic family-therapeutic solution-focused approach facilitating the establishment of a trustful and non-judgemental relationship. Nurses trained in CCHD were taught to guide the family in a participatory and reflective dialogue and to use illustrations and the BMI growth chart as tools. In this way, the nurses were trained to support a process in which the child and its parents identified strengths and resources and strengthened health literacy (Figure 5).

When overweight or obesity was identified all family members were offered an additional visit 1–3 weeks after the 4-year health visit followed by the regular 5-year health visit. Additional extra visits or referral to a dietician, CHS psychologist, or the obesity team were offered on request of the parents. Children with obesity were referred to the obesity team outside the primary care setting, according to regional guidelines.
The universal part of CCHD

The universal part comprised a 10-minute structured dialogue between the 4-year-old child, the parent(s), and the nurse using animated illustrations with various everyday life situations based on important protective healthy choices and family routines that are associated with a long-term healthy lifestyle. This part also included a neutral discussion on the child’s growth using the BMI growth chart.

The nurse, who was instructed to sit across from the child and the accompanying parent(s), introduced each illustration to the child first, followed by an open dialogue with the child and the parent(s). The nurse was trained to follow the child’s initiatives, to listen actively and give them the opportunity to state their preferences, knowledge and skills (Sommer et al. 2009, Trollvik et al. 2013, Freeman 2015). After each illustration the nurse summarised the dialogue, recapped the health message and invited the parent(s) to air additional reflections. In the dialogue the nurse encouraged parental involvement to support the entire family and tailored the dialogue to meet the
preferences and needs of the family (Edvardsson et al. 2011, Stenhammar et al. 2012). Additionally, the child received a storybook including all illustrations to be read at home with other family members.

**Illustrations**

The eight interactive illustrations formed a story about a cartoon character, named ‘troll’, who has thoughts about:
1) vegetable and fruit intake
2) varied food intake for adequate nutritious value
3) portion size
4) intake of water instead of sugary drinks
5) active play
6) sedentary activities
7) regular tooth brushing routines
8) bedtime routines

The illustrations were developed by a professional illustrator in collaboration with preschool teachers and CHS professionals (Figure 6).

An instruction guide with possible open-ended questions was made available to standardise the health dialogue, but the nurse was encouraged to listen carefully to what the child and the parent(s) said and respond to their reflections (Figure 6).

**BMI growth chart**

The BMI growth chart was used as a tool in both the universal and the targeted part of CCHD to discuss a normal growth trajectory in young children. In CCHD nurses were trained to print the BMI chart and draw the natural decreasing trend and the following normative rise in BMI. (Figure 7).

The BMI growth chart was also used to identify overweight or obesity using the IOTF definitions (Cole et al. 2000) and could help the family identify habits that might have driven BMI upwards. In this way, the BMI growth chart was used to encourage parents to make changes towards a healthy lifestyle (Perrin 2010, Regber 2013b).
Look, here we have a little troll that waves at all the fruits, do you recognise any of them? Have you tasted any of them? Which do you like best? Do you normally eat fruit and vegetables?

Here the little troll watches food running to the plate, but what are they? Do you recognise any of the food items? Is there anything you usually have on your plate? What food do you like best?

And here the little troll is licking his lips and wondering what might be in all these glasses? What do you think? What do you like to drink most? What does the body like best? What do you usually drink?

Here the big troll tells the little troll that the size of your hand tells you how much food can be just right for you. One hand of meat-fish-falafel, one hand of rice-potato-pasta and one hand of vegetables-fruit.

Now the troll is with friends. What are they doing? What looks like most fun? Do you usually do any of these things? Which ones? What do you like to do most? What do you need when you cycle?

Now the troll is indoors. What do you usually do when playing indoors? What do you like most? In my family you can’t play computer or tablet too long, how is it for you? I like to listen to fairy tales, do you like that too?

Now the troll is going to bed, but before that he brushes his teeth. The toothbrush looks tired. He needs to work both morning and evening. When does your toothbrush work?

Now the troll is really tired and has fallen asleep in his bed. It looks like the troll is dreaming something. Have you dreamt sometimes? What do you usually do before you go to sleep?

**Figure 6.** Illustrations used in CCHD and the suggested open-ended questions
Family Guidance – the targeted part of CCHD

The targeted part involved a 45-minute Family Guidance and was offered to children identified with overweight or obesity, their parents, and other adults important to the family, 1–3 weeks after the universal health visit. Family Guidance was inspired by SOFT, which is an evidence-based treatment model for children with obesity that engages all family members through collective family support (Nowicka and Flodmark 2011). The BMI growth chart was used in a non-judgemental discussion to identify already existing protective factors that are sustainable and to clarify the importance of sustainable weight stabilisation instead of weight loss (Brown and Perrin 2018, Sjunnestrand et al. 2019).

When it comes to how the family should act to change its lifestyle, health professionals did not propose precise instructions, but instead influenced the context of change through collaborative family support to encourage parents to find their own solutions (Nowicka and Flodmark 2011). CCHD acknowledged the complexity underlying the development of overweight and the advantage of small changes at an early age.

During the Family Guidance, participation of all family members, including the child was emphasised. Previous research described how children ask to be involved in their care and want to receive age-appropriate information on their own health status.
(Coyne and Gallagher, 2011). Discussing the child’s weight development in a positive and non-blaming manner, understandable for the child and the rest of the family and focusing on health and healthy behaviours, might set an example in how the child and the family could further communicate about it in their daily lives – especially since parents ask for guidance in how to talk about weight issues with their children (Ames et al. 2020).

**Training and tutorial sessions**

In both Study A and Study B nurses allocated to execute intervention care took part in a 1-day workshop in small groups (10 participants on average) about how to execute CCHD. The training, described in Castor et al. (2020), taught nurses how to apply CCC and how to apply the family-therapeutic solution-focused approach in order support the family in choosing small changes in lifestyle that according to the family are easiest to sustain (Castor et al. 2020).

Nurses in Study A were trained in February 2015, while nurses in Study B were trained in October-November 2016.

Tutorial sessions of one hour each, every two months at the CHC, were offered to give nurses the possibility to reflect and discuss how to execute the intervention in daily practice and how to handle the challenges.

The trainers were a nurse who had many years of experience as a CHS nurse and had been active in the development of CCHD and a nurse who had 15 years’ working experience in treatment of children with obesity and SOFT. The latter was also responsible for the tutorial sessions. The author of the thesis was present at some of the workshops, but did not teach.

**Outcomes**

Table 2 describes the primary and secondary outcomes of Study A and Study B.

**Primary outcome**

In the intervention group of Study A and in all children in Study B weight and height were collected at baseline, at the 4-year health visit and then followed longitudinally until follow-up at the 5-year health visit to calculate zBMI-change (Paper I, Paper II).

**Secondary outcomes**

The secondary outcome in Study A was the prevalence of overweight and obesity at the 12-month follow-up (Paper I).
In Study B the secondary outcomes were BMI-change (Paper II), changes in child lifestyle factors (intake of fruit, vegetables and sugary drinks) and family routines (tooth brushing and bedtime routines (Thesis).

Secondary outcomes that evaluated adverse events were the prevalence of obesity and underweight at the 12-month follow-up (Paper II) as well as changes in parental restrictive feeding practices and concerns about child eating and overweight (Thesis).

To perform an economic evaluation in children with overweight data on the number of Family Guidance (intervention group only), extra visits between the 4-year and the 5-year health visit, referrals and parents present were collected (Paper II).

### Table 2. Overview outcomes, data collection and time frame

<table>
<thead>
<tr>
<th>Study</th>
<th>Paper</th>
<th>Outcomes</th>
<th>Data collection</th>
<th>Time frame</th>
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<tbody>
<tr>
<td>A</td>
<td>I</td>
<td>- zBMI-change (primary)</td>
<td>- case-reports</td>
<td>- baseline June 2015 to July 2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- prevalence of overweight and obesity (secondary)</td>
<td>- electronic medical records</td>
<td>- follow-up June 2016 to July 2017</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- prevalence of underweight (harm)</td>
<td></td>
<td></td>
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<tr>
<td>B</td>
<td>II</td>
<td>- zBMI-change (primary)</td>
<td>- electronic medical records</td>
<td>- baseline January 2017 to November 2018</td>
</tr>
<tr>
<td></td>
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<td>- BMI-change (secondary)</td>
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<td>- follow-up January 2018 to December 2019</td>
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<td>- prevalence of obesity or underweight (harm)</td>
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<td></td>
<td></td>
<td>- cost evaluation (number of visits, referrals) (secondary)</td>
<td></td>
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<tr>
<td>Thesis</td>
<td></td>
<td>- change in child’s lifestyle and family routines (secondary)</td>
<td>- HLQ</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>- parental feeding practices and concerns for overweight (harm)</td>
<td>- CFQ</td>
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### Process evaluation

A process evaluation was performed to explore the mechanisms through which the intervention might have produced change and to better understand the context in which the intervention was delivered. The process evaluation used both quantitative and qualitative methods (Bonell et al. 2012, Moore et al. 2015).

**Understanding possible mechanisms**

Since the intervention was rooted in the theoretical concepts of child-centred care, health literacy and self-efficacy children’s experiences of the intervention were explored focusing on the concepts of child-centred care and children’s health literacy (Paper III),
while perceived parental self-efficacy in promoting a healthy diet and physical activity was examined among parents (Paper IV).

**Understanding the context**

To be able to interpret the findings and understand the context in which the intervention was tested there were regular meetings between the research group and the nurse responsible for the tutorial sessions. These meetings were used to collect data on the number of tutorial sessions and changes in nurses working at the CHCs.

To evaluate fidelity to the study protocol in Study B, data on the use of the illustrations and BMI growth chart and documentation of overweight was collected in children with overweight as well as nurses’ perceived knowledge and competence (Paper II).

**Data collection**

**Case reports**

In Study A data on age, gender, weight, and height of the child and date of the health visit were registered by the nurse directly after the 4-year health visit on a case report for children in the intervention. During the 5-year health visit, 1 year after CCHD, age, weight, and health were collected on the same form. Each child’s BMI was calculated, converted to zBMI, and then categorised into normal weight, overweight, obesity and underweight using the IOTF standard definitions (Cole *et al.* 2000).

**Electronic medical records**

In Study A age, gender, weight, and height for children that had visited one of the eight CHCs assigned as register control group were collected retrospectively at the age of 4 and 5 from Profdoc Medical Office (PMO) by the author of the thesis.

In Study B age, gender, weight, and height, BMI, weight category of the child and date of the visit were collected at baseline, at the 4-year health visit and then followed longitudinally until the 5-year health visit, 12 months after the intervention. These data were obtained via Qlikview, a tool used in primary care in Skåne to retrieve data from PMO.

For children with overweight at baseline in Study B, the author of the thesis collected the following data documented by the nurse from PMO: name of the nurse, number of extra visits, including information on offering and executing Family Guidance, number of referrals and acceptance of a referral, number of parents present at the regular 4-year health visit as well as at extra visits. Information about the use of illustrations, BMI growth chart as well as whether overweight was documented by the nurse during the 4-year health visit. Nurses had also documented the parents’ mode of transport to the CHC and type of leave of absence. Distance between the postcode of
the child’s home address and the postcode of the CHC were calculated by the author of the thesis using a website (https://www.postnummersok.se/sv/distance).

**Instruments**

To evaluate effects of the intervention in Study B the following instruments were used:

– The Healthy Lifestyle Questionnaire (HLQ)

– The Child Feeding Questionnaire (CFQ)

– The Parental Self-Efficacy for Promoting Healthy Physical Activity and Dietary Behaviours in Children Scale (PSEPAD)

The surveys were sent by normal post to the child’s home address by the nurse before attendance to the 4-year health visit. The nurse had an extra copy of the survey that was offered during the 4-year health visit if necessary. Parents who completed the baseline surveys received a follow-up survey 12 months after the intervention, sent by the author of the thesis. Reminders were posted after six weeks.

**HLQ** was developed as a public health survey to describe the health situation, living conditions, and lifestyle among 4-year-old children and their parents in Skåne in 2013 (Köhler *et al.* 2017), but was not validated. The HLQ included parental socio-demographic factors and inquiries about psychosocial factors such as economic situation, stress, and social support answered separately for mothers and fathers only at baseline. Questions about the child’s and parents’ lifestyle were answered by one parent or both parents together, both at baseline and at the 12-month follow-up.

Parental sociodemographic factors such as parental age, weight, height, the child’s and the parents’ country of birth (Sweden, other European country or other country outside Europe), parents’ education (elementary school (9 years or less), upper secondary school (for 2, 3, or 4 years), university level and other education) were used (Paper IV, Thesis) and data from specific questions about the child’s lifestyle: intake of fruit and vegetables, intake of sugary drinks, tooth brushing, and bedtime routines (Thesis).

The questions on the number of hours of active playtime and sedentary activities could not be used. The questions had been formulated inaccurately and therefore some parents had answered in hours per day, while others had interpreted the questions as hours per week, which was impossible to convert.

**CFQ** measuring parents’ perceptions and concerns about child eating and overweight and parental feeding practices was validated using conformity factor analysis in a Swedish population-based study involving a large sample of mothers of 4-year-old children (Birch *et al.* 2001, Nowicka *et al.* 2014). The Swedish version consists of 29
items out of 31 original items, loading on seven factors that measure parental perceptions of body weight, concerns about the child’s eating and overweight and parents’ feeding practices.

In Study B, all factors were answered separately by mothers and fathers at baseline and at the 12-month follow-up, but only two factors were used as variables for adverse events (Thesis). Mean scores for each factor were calculated and higher scores for each practice, represented more frequent use.

A. Restrictive feeding practices: six items, for example: ‘I have to be sure that my child does not eat too many…’. The responses are coded on a 5-point Likert scale ranging from 1–5, for example 1=disagree, 2=slightly disagree, 3=neutral, 4=slightly agree, and 5=agree. Cronbach’s alpha in mothers and fathers was 0.8 at baseline and follow-up.

B. Concerns about child eating and overweight: three items, for example: ‘How concerned are you about your child eating too much?’ and ‘How concerned are you about your child becoming overweight?’ The responses options were 1=unconcerned, 2=a little concerned, 3=concerned, 4=fairly concerned, and 5=very concerned. Cronbach’s alpha in mothers was 0.7 at baseline and 0.8 at follow-up and in fathers 0.8 at baseline and 0.7 at follow-up.

PSEPAD measured parents’ beliefs in their ability to promote healthy eating and physical activity behaviours and was developed and validated using exploratory factor analysis in a Swedish population of mothers of 3-year-old children for use in the context of childhood obesity prevention (Bohman et al. 2016). Of the original 16 items a total of 14 items loaded on three factors in the Swedish population: one for parental self-efficacy in promoting healthy dietary behaviours, one for promoting healthy physical activity behaviours and one for limit-setting of unhealthy behaviours. All responses were coded on an 11-point Likert-type scale ranging from 0 to 10, with the following anchors: 0=not at all, 2=to a very low degree, 4=to some degree, 6=to quite a degree, 8=to a high degree, 10=to a very high degree.

All factors of PSEPAD were answered separately for mothers and fathers at baseline and at 12-month follow-up. Only factors A and B were used (Paper IV):

A. Parental self-efficacy in promoting healthy dietary behaviours in children: 6 items, for example ‘How confident are you that you can promote healthy eating habits for your child?’ (Maximum score 60 points).

B. Parental self-efficacy in promoting healthy physical activity behaviours in children: 3 items, for example: ‘How confident are you that you can get your child engaged in physical play indoors and outdoors?’ (Maximum score 60 points).
For factor A and factor B Cronbach’s alpha in mothers and fathers was 0.8 at baseline and follow-up.

**Costs**

Direct health-care costs for the 4-year health visit, Family Guidance, extra visits and for administration of referrals were translated into monetary units and calculated using the nurses’ average salary rates, including employers’ contribution to social and collectively agreed private pensions and time (Statistics Sweden 2020). Costs for referrals to an obesity team, dietician or CHS psychologist were calculated based on the Swedish southern regional healthcare pricelist for the year 2017. Indirect costs for parents participating in the visits were calculated based on average wage rate, travel costs, including time costs and type of leave of absence. Way of transport or type of leave were collected during the 4-year health visit by the nurse.

Costs for the training and tutorial sessions were based on wage rate and time for the trainers and the participating nurses, material costs, catering, and transport to the training. Information on preparation time and way of transport to the training was gathered during the training and the tutorial sessions by one of the trainers.

**Non-participation observations**

In the qualitative part of Study B non-participant observations were performed in May and June 2018 to gain a direct understanding of CCHD in the natural context of the 4-year health visit at a CHC (Liu and Maitlis 2010). In the non-participant observation, the author of this thesis took a passive role and only observed interactions between the child, the accompanying parent(s) and the nurse, while all participants were aware of the presence of the researcher (Greig et al. 2013). The non-participant observation gave the opportunity to listen to the views expressed by the children, their parent(s) and the nurse, but also to capture the non-verbal communications and to see how the children experienced the illustrations. The duration of CCHD ranged from 7.5–14.5 minutes, with an average of 10.5 minutes of the total 60 minutes the 4-year health visit lasted. During the observation key words were written down and detailed field notes were written directly after each health visit to note what had been observed (Liu and Maitlis 2010).

**Interviews**

Individual interviews with 4-year-old children were performed by the author of this thesis in the child’s home in the presence of a parent, 0–7 days after the visit, with an average of 3 days. A thematic interview guide was used with open-ended questions categorised in different themes: how the child experienced the dialogue, how the child interpreted the different illustrations and reflections on the illustrations used during the dialogue at the CHC (Appendix 1). Other questions focused on what the child itself liked to eat, drink, and do, and their ideas about what the body in general liked to eat,
drink, and do. Depending on the experiences and illustrations used during CCHD, the context, time frame and child’s interests, the interview guide was used in a flexible way (Nilsson et al. 2015).

To get acquainted with the child and to build trust and a relationship based on understanding and respect, the interview started with a game called Memory (Doverborg and Pramling Samuelsson 2012). The game was created by the author of the thesis and included parts of the eight animated illustrations used in CCHD (Appendix 2). It served as a start to the interview, asking about their experiences when the game was played. Questions asked were, for example: ‘What is it you see, have you seen it before, can you tell me about it?’

Another artefact that was used to create a conversation with the child was a fabric puppet looking like ‘the troll’ (Appendix 2). The troll asked the child: ‘Hi, do you remember me, it’s me Troll. I was there on some pictures that also showed fruits, vegetables, and activities, do you remember? What were the pictures about?’ The story book and the eight illustrations were other tools facilitating the interviews.

The first two interviews were performed as pre-interviews to see if the questions were suitable and as no changes were made in the interview guide, they were included in the data material. The interviews lasted from 11–50 minutes with an average of 36 minutes. They were recorded and transcribed verbatim by the author of the thesis.

The fidelity questionnaire

A fidelity questionnaire was developed by the research group to describe usual care in Study A, containing 11 questions about perceived knowledge and competence in promoting healthy lifestyle and child overweight as well as actual practices regarding the use of illustrations, BMI growth chart, and delivery of care to children with overweight and obesity. In Study A this anonymous questionnaire was distributed to all nurses working in CHS in Skåne in May 2016 (Paper I) and in Study B to nurses in both groups in December 2017 and July 2018 (Paper II, Thesis).

Sample size

According to the power calculation sample size in Study B needed to consist of at least 2,500 four-year-old children in each group of which 250 children with overweight, assuming a prevalence of 10%, to detect a clinically important difference in mean zBMI-change of 0.25 units in 4-year-old children with overweight at the 12-month follow-up with a power of 0.80 and a significance level of 5% (Grossman et al. 2017).
Sample size was not adjusted for clustering effects within the CHCs when power was calculated, but the outcomes were adjusted for clustering effects afterwards. The assumption of a 10% prevalence proportion of overweight was based on the mean prevalence of overweight in 4-year-olds (intervention and control) at baseline in Study A.

**Stratification and randomisation**

Study A had a quasi-experimental design and was therefore non-randomised.

Study B, however, applied the following process of stratification and randomisation.

The 37 CHCs that accepted participation were first stratified according to CNI in two different strata. One stratum consisted of CHCs with a CNI below the mean CNI in Skåne in 2015 (<0.93) and the second stratum was formed by CHCs with a CNI above the mean (≥0.93). Stratification for CNI was important to be able to examine whether the intervention unintentionally increased health inequalities (Brown *et al.* 2019).

Thereafter, all CHCs were divided into groups that executed either usual care or intervention care (1:1). Random allocation was performed by a statistician according to a computer-generated randomisation list. The allocation sequence was revealed to the author of this thesis, who contacted all CHCs.

**Similarity of the interventions**

In Study A nurses in the intervention and in the control group performed a health dialogue at the 4-year health visit and offered extra visits when overweight was identified. Nurses in the intervention group were trained in a childhood obesity and in CCHD’s structured model, approach and tools and offered Family Guidance when overweight or obesity was identified.

Before the start of Study B, all CHS nurses working in Skåne received a 120-minute traditional lecture on child overweight and the BMI growth chart in May–June 2016. Moreover, the CCHD illustrations were published on RHB in June 2016 after the publication of a master’s thesis, exploring the experiences of the six nurses participating in Study A (RHB 2021a). This study showed that nurses experienced development in their profession and felt more confident in talking about healthy diet with children and their parents (Håkansson 2015).

Nurses in the control group in Study B performed a health dialogue at the 4-year health visit and might have used the illustrations. They also offered extra visits when overweight was identified. Nurses in the intervention group were trained to use CCHD’s approach and tools.
Data analysis

Statistical analysis

In Study A, a two-sample t-test was used to compare the mean zBMI-change at the age of five, 12 months after the intervention, while Fisher’s exact test was used to compare the prevalence of overweight and obesity at the age of 5 in children with normal weight at baseline. As the number of children with overweight, obesity, and underweight was small and the aim of this feasibility study was to test the responsiveness of the outcomes, these groups were not subjected to statistical significance testing.

In Study B, intention-to-treat analysis was used and children were randomised to either the intervention or the control group at CHC level. Children in the intervention group who had visited a nurse who was not trained in CCHD and therefore had not received the intervention were excluded from the analysis. In the primary analysis a linear mixed regression model was used to compare the primary and secondary outcomes and to adjust for clustering effects. In a secondary analysis the intervention effect was also adjusted for baseline, gender, and CNI using a linear mixed regression model. The secondary outcomes restrictive feeding practices, and concerns for child eating and overweight (Thesis) were analysed for mothers and fathers separately, as well as for parental self-efficacy (Paper IV). To compare the prevalence of obesity at the age of 5 and the number of documented children with overweight at baseline, Fisher’s exact test was used (Thesis).

To demonstrate variations in intervention effect on the primary outcome, sub-analyses based on gender and CNI were performed (Paper II).

In the surveys answered by mothers and fathers all items in a specific factor were removed when one or more items were missing without imputing unknown values (Paper IV, Thesis). The interaction between intervention, change in parental self-efficacy, and zBMI-change was tested in children with normal weight, overweight, or obesity to examine a potential moderating effect of parental self-efficacy in mothers and fathers on the primary outcome zBMI-change. A linear mixed regression model was used, including a ‘group x change in parental self-efficacy’ as interaction term. In this analysis, children with underweight were excluded as they should increase in zBMI instead of desired stabilisation (children with normal weight) or decrease in zBMI (children with overweight and obesity). Interactions that showed a significance level of \( p<0.05 \) were further explored with a subgroup analysis.

The software package IBM SPSS Statistics 27 was used for all statistical analyses and the significance level was set at \( p<0.05 \).
Economic analysis

An economic analysis of delivery of care for children with overweight at baseline was performed in Study B as this was the main difference in delivery of care between the control and intervention groups (Paper II). Children with obesity were excluded as regional guidelines require that they should be referred to specialist care outside the primary care setting. The economic analysis applied a wider societal perspective and looked at both direct and indirect health care costs. It used two effectiveness indicators: a) zBMI-change and b) BMI-change.

To test the hypothesis that CCHD is less expensive than usual care for children with overweight, because of less excessive referrals and extra visits, the incremental costs were calculated by adding the costs for delivery of care plus the costs for training per child with overweight in the intervention group subtracted by the costs for delivery of care per child with overweight in the control group. Then, two incremental cost-effectiveness ratios (ICER) were calculated by dividing the incremental costs by the difference in mean a) zBMI-change and b) BMI-change in the intervention and control group (Drummond et al. 2015). The ICER was expressed as costs per 0.1 zBMI or costs per 1 BMI unit prevented.

Qualitative content analysis

The qualitative part of Study B used inductive content analysis according to Elo and Kyngäs (2008) and included not only spoken text but also the latent content, noticing postures, laughter, and silence (Elo and Kyngäs 2008). The analytic process started with making sense of the content in its entirety and identifying essential features in the field notes and the transcribed interviews before organising the material in codes that appeared to elucidate the experiences of the children. These codes were then discussed with the co-authors of Paper III to guarantee that they truly described the child’s perspective. In the next step sub-categories were created comparing the codes with regard to differences and similarities and then abstracted into generic categories. The overall main category was formulated after discussions with fellow researchers in the field of child health and child participation (Paper III).

Pre-understanding

The author of the thesis had previous knowledge about child obesity and how it affects children before the start of this thesis. She was trained as a paediatrician, but decided to study medical anthropology at the University of Amsterdam, the Netherlands, to better understand children’s perspectives on health and well-being. She performed a qualitative interview study to explore the experiences and perceptions of children with overweight and body size (Derwig 2014). Then she worked for four years in an obesity team with SOFT treating children aged 4–18 with severe obesity at the Centre for Childhood Obesity in Malmö, Sweden.
Understanding the need for prevention, she then changed position and now works at the Centre of Excellence for CHS in Skåne. Here she learned that nearly all families visit CHS and that food preferences, activity levels, and leisure activities are influenced by parents and the home environment early in life (Rudolf 2009).

This pre-understanding was repeatedly reflected upon and critically considered throughout the entire research process together with the research group to minimise the risk that it would influence the interpretation of data in a biased way.

Ethical considerations

All studies were planned and carried out in compliance with the ethical principles of the Declaration of Helsinki (WMA 2013), the Swedish Act concerning the Ethical Review of Research Involving Humans (Swedish Government 2003), the General Data Protection Regulation (Swedish Authority for Privacy Protection 2021) and the UN Convention on the Rights of the Child (UNICEF 1989). In all studies the balance between non-maleficence against beneficence was taken into consideration, so that possible harms and inconveniences for the study participants would not outweigh the scientific benefits (Beauchamp and Childress 2013). The principles of autonomy were met by the freedom to take part and by informing children and their parents about their right to withdraw their participation at any time (Beauchamp and Childress 2013). The principle of justice was also applied when randomisation was generated by a computer (Beauchamp and Childress 2013).

Research approval

Study A obtained ethical approval (2015/223) before recruitment of children in the intervention group. Parents visiting the three CHCs that executed intervention care invited all children and their parents that came to their 4-year health visit to participate in the study. Parents received information from the nurse and a letter about the study at the 4-year health visit. After the consent of both parents the child received a study code and was included in the study. Study data were kept safely separate from personal data to maintain confidentiality. Before collecting data for the control group, the research approval was adjusted so that all children that came to their 5-year health visit at one of the eight CHCs that executed usual care were included as a register control group unless parents had actively declined participation in the study. Parents, informed by the study by a poster in the waiting and nurse’s reception room, could opt out of the study if they did not want their child’s age, gender, weight, and height data to be collected. In Study A no parents chose to opt out.
The ethical approval of Study B was approved (2016/721) and research data were collected for all children that were invited to the 4-year health visit, unless parents had opted out. As in Study A, parents were informed by a poster, identical for the control and intervention groups. In Study B there were 25 parents that wished to opt out.

All parents with sufficient knowledge of the Swedish language received an information letter including a research code and the allocation of their CHC to either usual or intervention care one month prior to their child’s 4-year health visit. The letter included an informed consent, hard-copy surveys and an invitation to a digital version of the surveys.

Because the qualitative study for Paper III involved active participation of children, a separate application for ethical approval was submitted and approved (2018/151). Nurses at six CHCs sent an information letter to the parents, including an age-appropriate letter for the child (Appendix 3). Children participated in the study after repeated oral informed assent and written informed consent from both parents. Five children and their parents exercised their right and did not participate in the interview, but consented that data from the non-participatory observation could be used in the data analysis.

**Involving children in research**

The qualitative part of Study B aimed to explore the children’s experiences from the child’s point of view as part of the evaluation of the development of a child-centred intervention. When involving children in research it is important to obtain and produce scientific information without harming the children, while constantly guarding their rights (Beauchamp and Childress 2013, Källström and Andersson Bruck 2017). To inform the children about their freedom to take part and to withdraw at any time, children were asked before and after the observation, again just before the interview and several times during the interview for their oral assent. Asking 4-year-old children repeatedly for their consent to participate, and continuously observing any signs of desire to pull out the observation or the interview, was intended to increase their understanding of the purpose of the study and their right to withdraw, especially since 4-year-olds have the tendency to live in the here and now (Nilsson et al. 2015). All parents were assured that they had the liberty to withdraw from the study at any time without affecting their child’s healthcare in anyway (Beauchamp and Childress 2013, Källström and Andersson Bruck 2017).
Informed consent and assent

The Swedish Act concerning the Ethical Review of Research Involving Humans states that if a research person is under 15 years of age, both parents must be informed of and consent to the research (Swedish Government 2003). An information letter should contain information about the purpose, the methods, potential harms, and inconveniences, how data will be stored and how the findings will be used, sources of funding and research affiliates. The Act also states that if children do not have the competence to sign an informed consent they have the right, regardless of their age, to be informed about the research in an age-appropriate way.

Informed consent means a considered and voluntary consent to participate in research (Beauchamp and Childress 2013). Informed consent can be used with children that are judged to have sufficient competence about what will happen when they sign an informed consent and understand the consequences of such a decision. In other words, children that are asked to sign an informed consent will have to understand the meaning and the consequences of informed consent.

Informed assent is like informed consent, but when the child is judged not to have sufficient competence to understand and assess all the consequences of signing an informed consent. The parents of the child are then required to sign on behalf of the child, while the child is requested to assent to the study orally.

In this way, the question whether to ask children for informed consent or informed assent depends on the judgement of the child’s competence. According to Beauchamp and Childress (2013) children’s competence should be assessed based on their ability to perform a task in a specific situation at a specific time and not according to what opinions children have. The concept of competence is complex and can be described as the degree to which one has different abilities, for example to be able to weigh risks and opportunities as well as advantages and disadvantages against each other and to think long-term. Children’s competence is affected by the child’s development and experiences and largely follows the development and maturation process of each individual. Perception of time and being able to reason about time generally develops when children start school, while younger children live completely in the present (NBHW 2015, Källström and Andersson Bruck 2017).

Therefore, children in the qualitative part of Study B were asked for their assent and not for their consent, as preschool children were judged not to have the competence to assess the consequences of signing an informed consent. Both children and parents were informed and were given relevant and easy-to-understand information, both oral and written, to be able to make a considered choice. The child’s information letter contained illustrations and easily comprehensible language (Appendix 3). Both children and parents were given time and opportunity to ask questions and to consider the matter in peace and quiet before making their decision.
Results

After describing the participant flow and baseline data, the results of Study A and Study B were merged and presented in three sections: effectiveness, cost-effectiveness, and process evaluation. Study A showed that CCHD was feasible on a small scale and that nurses trained in the intervention were able to execute CCHD using its approach and tools (Paper I). The responsiveness of outcomes and adverse effects were assessed and are described under effectiveness. The primary and secondary outcomes of Study B in children with normal weight and overweight are reported under effectiveness. The assessment of cost-effectiveness for children with overweight in Study B are presented under cost-effectiveness. The child’s experiences and changes in parental perceived self-efficacy are portrayed under process evaluation to inform about possible mechanisms of the process of change. For a broader comprehension of the context, fidelity to the study protocol as well as perceived knowledge and competence of nurses is described under process evaluation.

Participant flow and baseline data

This part describes the participant flow with losses and exclusions, the dates of recruitment and follow-up and the baseline data.

Children

In Study A the intervention group of 203 children was recruited between June 2015 and June 2016 with follow-up of 194 children between June 2016 and July 2017 (Table 2). Nine children changed CHC (Paper I, Figure 2). The register control group of 582 children was recruited between June 2016 and June 2017. Table 3 shows the baseline characteristics.

In Study B (Paper II) children in both the control group and the intervention group were recruited between January 2017 and November 2018. The follow-up was between January 2018 and December 2019. This resulted in 6,047 children who enrolled in the study: 3,015 received usual care, while 3,032 received intervention care. Some children discontinued the study because their parents had opted out or because of missing data at baseline. Children who were not brought to their 4-year health visit and children in
the intervention group who did not receive the intervention, because they met a nurse not trained in CCHD, were excluded from Study B. In the end, 3,003 children participated in the control group, while 3,005 children joined the intervention group at baseline, including 2,277 children with normal weight and 245 children with overweight in the control group and 2,321 children with normal weight and 245 children with overweight in the intervention group. The baseline characteristics are displayed in Table 3.

Table 3. Characteristics at baseline for Study A and Study B

<table>
<thead>
<tr>
<th>All 4-year-old children</th>
<th>Study A</th>
<th>Study B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control group n=582</td>
<td>Intervention group n=203</td>
</tr>
<tr>
<td>Age</td>
<td>4.1±0.1</td>
<td>4.1±0.1</td>
</tr>
<tr>
<td>Female</td>
<td>299 (51.4)</td>
<td>106 (52.2)</td>
</tr>
<tr>
<td>CNI≥0.93&lt;sup&gt;1&lt;/sup&gt;</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>zBMI</td>
<td>0.23±1.0</td>
<td>0.09±1.0</td>
</tr>
<tr>
<td>BMI (kg/m&lt;sup&gt;2&lt;/sup&gt;)</td>
<td>16.1±1.4</td>
<td>15.9±1.4</td>
</tr>
<tr>
<td>Weight categories</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal weight&lt;sup&gt;2&lt;/sup&gt;</td>
<td>450 (77.3)</td>
<td>156 (76.8)</td>
</tr>
<tr>
<td>Overweight</td>
<td>65 (11.2)</td>
<td>16 (7.9)</td>
</tr>
<tr>
<td>Obesity</td>
<td>9 (1.5)</td>
<td>4 (2.0)</td>
</tr>
<tr>
<td>Underweight</td>
<td>58 (10.0)</td>
<td>27 (13.3)</td>
</tr>
</tbody>
</table>

Data are presented as Mean±SD values or n(%).
<sup>1</sup>CNI≥0.93 is related to lower socioeconomic status.
<sup>2</sup>BMI categorised using IOTF definitions.

In the control group 52 children were lost to follow-up, compared to 50 children in the intervention group (Paper II, Figure 1), resulting in 2,233 children with normal weight and 237 children with overweight in the control group and 2,278 children with normal weight and 238 children with overweight in the intervention group. The flow chart of Study B is presented in Figure 8.

In the control group, 50% of children came from families with lower socioeconomic status at baseline compared to 45% in the intervention group (Table 3).
Figure 8. Flow chart of Study B
The study population of the qualitative part of Study B was recruited in May and June 2018 by nurses working at strategically situated CHCs that executed intervention care (Figure 8). They had varying working experience and strategically invited 30 children with regard to variation in sex, socioeconomic background and ethnicity.

To achieve optimum variation CHCs were situated in larger cities and smaller municipalities and had a listed population with higher and lower socioeconomic status (CNI). Of these, 2 CHCs had a CNI≥0.93, while 4 had a CNI<0.93, 3 CHCs were situated in larger cities and 3 CHCs in smaller communities.

The study sample contained 16 children, 9 girls and 7 boys who participated in both the observation and the interview, of which 3 children were born outside Europe, while 5 children (3 girls and 2 boys) participated in the observation only (Paper III, Table 1).

**Parents**

In Study B, parents of 4,500 children received the surveys by post: 1,995 in the control group and 2,505 in the intervention group. Excluded from the study were parents of children that did not participate in the 4-year health visit and those of children in the intervention group that did not receive intervention care (Figure 8).

Parents of 1,197 children responded to the survey, 491 in the control group and 706 in the intervention group (Table 4).

There were 1,115 mothers, 457 in the control group and 658 in the intervention group, and 869 fathers, 345 in the control group and 524 in the intervention group (Table 4).

Mothers and fathers were the biological parents in most cases; in 9 children in the control group and 6 in the intervention group, the responder was a female or male caregiver that lived together with the biological parent. These were included in mothers or fathers.

Parents of 317 children did not respond to the 12-month survey, 116 children in the control group and 201 children in the intervention group.

At the 12-month follow-up, there were 1,425 parents of 880 children, in the control group 344 mothers and 247 fathers of 375 children and in the intervention group 473 mothers and 361 fathers of 505 children. The mean time difference between baseline and the 12-month survey was 1.1 years [SD 0.2] in both the control group and the intervention group.
Table 4. Characteristics of mothers, fathers, and children at baseline in Study B

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Control group</th>
<th>n</th>
<th>Intervention group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mothers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>457</td>
<td>36.5±4.4</td>
<td>658</td>
<td>36.2±4.4</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>448</td>
<td>24.1±3.9</td>
<td>649</td>
<td>24.1±4.1</td>
</tr>
<tr>
<td>University degree</td>
<td>327</td>
<td>248 (75.8)</td>
<td>474</td>
<td>363 (76.6)</td>
</tr>
<tr>
<td>Foreign background</td>
<td>332</td>
<td>75 (22.5)</td>
<td>477</td>
<td>79 (16.5)</td>
</tr>
<tr>
<td><strong>Fathers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>345</td>
<td>39.1±5.8</td>
<td>524</td>
<td>38.4±5.5</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>341</td>
<td>25.7±3.1</td>
<td>521</td>
<td>25.7±3.6</td>
</tr>
<tr>
<td>University degree</td>
<td>268</td>
<td>178 (66.4)</td>
<td>417</td>
<td>244 (58.5)</td>
</tr>
<tr>
<td>Foreign background</td>
<td>270</td>
<td>63 (23.3)</td>
<td>418</td>
<td>67 (16.0)</td>
</tr>
<tr>
<td><strong>Children</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>491</td>
<td>4.1±0.1</td>
<td>706</td>
<td>4.0±0.1</td>
</tr>
<tr>
<td>Female</td>
<td>491</td>
<td>261 (53.2)</td>
<td>706</td>
<td>359 (50.8)</td>
</tr>
<tr>
<td>CNI&gt;0.93¹</td>
<td>491</td>
<td>207 (42.2)</td>
<td>706</td>
<td>224 (31.7)</td>
</tr>
<tr>
<td>Born in Sweden</td>
<td>476</td>
<td>457 (96.0)</td>
<td>683</td>
<td>657 (96.2)</td>
</tr>
<tr>
<td>zBMI at baseline</td>
<td>490</td>
<td>0.06±0.94</td>
<td>706</td>
<td>0.11±0.89</td>
</tr>
<tr>
<td>Weight categories²</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight grade II &amp; III</td>
<td>17 (3.5)</td>
<td>16 (2.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight grade I</td>
<td>38 (7.8)</td>
<td>58 (8.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal weight</td>
<td>394 (80.2)</td>
<td>574 (81.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>36 (7.3)</td>
<td>51 (7.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obesity</td>
<td>5 (1.0)</td>
<td>7 (1.0)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data are presented as Mean±SD values or n (%).

¹CNI≥0.93 is related to lower socioeconomic status.
²BMI categorised using IOTF definitions.

*Child Health Centres and nurses*

In Study B, there were 2 CHCs that declined study participation, one in the control and one in the intervention group, because of time constraints. At baseline, the control group contained 18 CHCs: 10 CHCs with CNI≥0.93 employing 43 nurses. The intervention group consisted of 17 CHCs: 9 CHCs with CNI≥0.93 and 49 nurses.

During Study B, 26 nurses stopped working, 11 nurses in the control group and 16 nurses in the intervention group. There were 4 newly recruited nurses that could be trained in CCHD (Paper II).
Effectiveness

Primary outcome

The primary outcome in Study A and Study B was zBMI-change. Children with normal weight at baseline increased slightly in mean zBMI at follow-up in both the intervention and the control group in Study A and Study B. The adjusted mean difference in zBMI-change did not show any intervention effect (Table 5).

Table 5. zBMI-change and BMI-change in children with normal weight at follow-up

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th>Intervention group</th>
<th>Mean Difference (95% CI) (^1)</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children with normal weight at baseline in Study A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n=450)</td>
<td>(n=148)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>zBMI-change</td>
<td>0.07±0.47</td>
<td>0.04±0.49</td>
<td>-0.04 (-0.20 to 0.11)</td>
<td>0.55</td>
</tr>
<tr>
<td>BMI-change</td>
<td>-0.10±0.72</td>
<td>-0.16±0.70</td>
<td>-0.07 (-0.30 to 0.17)</td>
<td>0.52</td>
</tr>
<tr>
<td>Age</td>
<td>5.1±0.14</td>
<td>5.4±0.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children with normal weight at baseline in Study B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n=2,233)</td>
<td>(n=2,278)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>zBMI-change</td>
<td>0.06±0.48</td>
<td>0.04±0.46</td>
<td>-0.03 (-0.09 to 0.03)</td>
<td>0.35</td>
</tr>
<tr>
<td>BMI-change</td>
<td>-0.11±0.68</td>
<td>-0.14±0.68</td>
<td>-0.04 (-0.12 to 0.04)</td>
<td>0.33</td>
</tr>
<tr>
<td>Age</td>
<td>5.1±0.11</td>
<td>5.1±0.12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)Study A adjusted for cluster, baseline, and gender
Study B adjusted for cluster, baseline, gender and CNI

In Study B, children with overweight at baseline decreased in zBMI, while children in the control group slightly increased in zBMI. The mean difference in zBMI-change was -0.11 (95% CI: -0.24 to 0.01; \(p=0.07\)) adjusted for cluster, baseline, gender, and CNI (Table 6). This tendency was in favour of the intervention group, although statistically uncertain.
To evaluate the impact of the intervention on health inequalities, the effect of the intervention on zBMI-change was analysed in females and males and secondly in children with a lower socioeconomic status (CNI≥0.93) compared to children with higher socioeconomic status. The mean difference in zBMI-change in all subgroups was in favour of the intervention, but females and children coming from an area with a higher socioeconomic status had a larger mean change in zBMI-change and showed a tendency to an intervention effect (Table 6).

### Secondary outcomes

#### Change in BMI

BMI-change at follow-up in children with normal weight at baseline in Study A and Study B (Table 5) and in children with overweight in Study B (Table 6) is described to enable comparison of results with other studies that only present BMI-change as their primary outcome. In Study B the trend in BMI was in favour of children with

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**Table 6.** zBMI-change and BMI-change in children with overweight at follow-up in Study B, including subgroup analyses by gender and CNI.

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th>Intervention group</th>
<th>Mean difference (95% CI)&lt;sup&gt;1&lt;/sup&gt;</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Children with overweight</strong></td>
<td>(n=237)</td>
<td>(n=23)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>zBMI-change</td>
<td>0.01±0.50</td>
<td>-0.08±0.52</td>
<td>-0.11 (-0.24 to 0.01)</td>
<td>0.07</td>
</tr>
<tr>
<td>BMI-change</td>
<td>0.01±1.02</td>
<td>-0.18±1.01</td>
<td>-0.21 (-0.44 to 0.01)</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Females with overweight</strong></td>
<td>(n=128)</td>
<td>(n=129)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>zBMI-change</td>
<td>0.05±0.49</td>
<td>-0.08±0.52</td>
<td>-0.14 (-0.28 to 0.01)</td>
<td>0.06</td>
</tr>
<tr>
<td><strong>Males with overweight</strong></td>
<td>(n=109)</td>
<td>(n=109)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>zBMI-change</td>
<td>-0.03±0.51</td>
<td>-0.08±0.46</td>
<td>-0.06 (-0.25 to 0.13)</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>CHCs with CNI≥0.93</strong></td>
<td>(n=126)</td>
<td>(n=121)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>zBMI-change</td>
<td>0.01±0.51</td>
<td>-0.04±0.57</td>
<td>-0.09 (-0.30 to 0.12)</td>
<td>0.34</td>
</tr>
<tr>
<td><strong>CHCs with CNI&lt;0.93</strong></td>
<td>(n=111)</td>
<td>(n=117)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>zBMI-change</td>
<td>0.01±0.49</td>
<td>-0.12±0.46</td>
<td>-0.14 (-0.31 to 0.03)</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Data are presented as Mean±SD

<sup>1</sup>Primary analysis adjusted for cluster, baseline, gender and CNI; subgroup analyses adjusted for cluster.
overweight in the intervention group compared to the control group (Table 6), although statistically uncertain.

Child lifestyle and family routines

The reported mean scores at the 12-month follow-up and changes in the child’s lifestyle in Study B are presented in Table 7. The reported mean scores in fruit and vegetable intake and tooth brushing by an adult twice a day were high at follow-up and showed minor changes. The mean scores for intake of sugary drinks at mealtimes and between meals and no bedtime routines were low, with minor changes 12 months after the intervention. There were no statistical differences between the reported changes in the child’s lifestyle (Table 7).

**Table 7.** Child’s lifestyle at follow-up.

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th>Intervention group</th>
<th>Mean difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean ±SD</td>
<td>Mean change</td>
</tr>
<tr>
<td>Fruit intake</td>
<td>358</td>
<td>4.5±0.6</td>
<td>0.01</td>
</tr>
<tr>
<td>Vegetable intake</td>
<td>364</td>
<td>4.5±0.7</td>
<td>0.07</td>
</tr>
<tr>
<td>1:never; 2:1–2/week; 3:3–4/week; 4:almost every day; 5:&gt;once every day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugary drinks at mealtime</td>
<td>363</td>
<td>1.6±0.7</td>
<td>-0.02</td>
</tr>
<tr>
<td>Sugary drinks between meals</td>
<td>312</td>
<td>1.5±0.7</td>
<td>-0.04</td>
</tr>
<tr>
<td>1:never; 2:1–2/week; 3:3–4/week; 4:every day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tooth brushing by adult 2/day</td>
<td>368</td>
<td>0.8±0.4</td>
<td>-0.02</td>
</tr>
<tr>
<td>No bedtime routines</td>
<td>368</td>
<td>0.05±0.2</td>
<td>0.02</td>
</tr>
</tbody>
</table>
| 1:yes; 0:no

1Linear Mixed Model adjusted for cluster, baseline, gender and CNI

Adverse events

The adverse events described are prevalence of underweight and obesity at follow-up and parental restrictive feeding practices and concerns about eating and overweight.
Prevalence of underweight and obesity at follow-up

In Study A, none of the children with normal weight at baseline in the intervention group developed underweight or obesity at the 12-month follow-up (Paper I).

In Study B, the development of weight according to the IOTF categories of children with normal weight and overweight from baseline to follow-up is presented in Table 8.

In children with normal weight at baseline the proportions of children in the intervention group that developed either underweight, overweight, or obesity were comparable to the proportions in the control group (Table 8).

None of the children in the intervention or the control group with overweight at baseline developed underweight. Twenty-six children (11.0%) with overweight at baseline in the intervention group developed obesity compared to 40 children (16.9%) with overweight in the control group. This difference in prevalence in obesity at follow-up showed a statistically uncertain tendency in favour of the intervention ($p=0.06$).

Table 8. Development of BMI categories from baseline to follow-up in Study B

<table>
<thead>
<tr>
<th>At follow-up</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal weight</td>
</tr>
<tr>
<td>Normal weight at baseline</td>
<td>1,983 (88.8)</td>
</tr>
<tr>
<td>Control group</td>
<td>2,038 (89.5)</td>
</tr>
<tr>
<td>Intervention group</td>
<td></td>
</tr>
<tr>
<td>Overweight at baseline</td>
<td>58 (24.5)</td>
</tr>
<tr>
<td>Control group</td>
<td>77 (32.4)</td>
</tr>
<tr>
<td>Intervention group</td>
<td></td>
</tr>
</tbody>
</table>

Parental restrictive feeding practices and concerns about eating and overweight

Parental restrictive feeding practices as well as concerns about the child eating and overweight were also assessed as adverse events in Study B. Restrictive feeding practices slightly decreased in mothers and fathers in the intervention group, but no significant differences were found. Concerns about eating and overweight had low mean scores in both the control and the intervention group at follow-up, with minor changes and no significant differences (Table 9).
Table 9. Feeding practices and parental concerns at follow-up in Study B.

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th></th>
<th>Intervention group</th>
<th></th>
<th>Mean difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean ±SD</td>
<td>Mean change</td>
<td>n</td>
<td>Mean ±SD</td>
</tr>
<tr>
<td>Mothers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restrictive feeding</td>
<td>337</td>
<td>2.8±0.9</td>
<td>0.05±0.85</td>
<td>466</td>
<td>2.7±1.0</td>
</tr>
<tr>
<td>practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1=disagree–5=agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concerns eating and</td>
<td>344</td>
<td>1.2±0.6</td>
<td>0.03±0.37</td>
<td>475</td>
<td>1.3±0.6</td>
</tr>
<tr>
<td>overweight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1=unconcerned–5=very</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>concerned</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fathers</td>
<td>248</td>
<td>2.7±0.9</td>
<td>-0.03±0.92</td>
<td>360</td>
<td>2.8±1.0</td>
</tr>
<tr>
<td>Restrictive feeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>practices</td>
<td>245</td>
<td>1.2±0.5</td>
<td>-0.02±0.43</td>
<td>363</td>
<td>1.3±0.5</td>
</tr>
<tr>
<td>1=disagree–5=agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concerns eating and</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>overweight</td>
<td>1=unconcerned–5=very concerned</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data are presented as Mean±SD
Costs

Costs for training in the intervention were estimated to be 41,566 euros in total, 799 euros per nurse (49 nurses) and 14 euros per child regardless of weight (3032 children) and 175 euros per child with overweight (238 children with overweight) in Study B (Paper II, Table 3). Both direct and indirect cost (transport and loss of productivity were included to enable calculation of the cost-effectiveness from a societal perspective (Paper II, Table 4).

Delivery of care for children with overweight in the control group was estimated at 23,011 euros (97 euros per child with overweight) and in the intervention group 20,700 euros (87 euros per child with overweight) (Paper II, Table 4).

Children in the control group had received 19 referrals in comparison to 11 referrals in children with overweight in the intervention group and a comparable number of extra visits (Paper II, Table 4). In the control group children received 59 extra visits, of which 12 children received two or three extra visits compared to 60 extra visits in the intervention group (26 Family Guidance and 34 regular extra visits), of which 2 children received two extra visits.

Dividing the incremental costs of the intervention of 167 euros per child with overweight by the mean difference in zBMI-change resulted in an ICER for zBMI-change of 183 euros per 0.1 zBMI unit prevented. The ICER for BMI-change was 866 euros per 1 BMI unit prevented (Paper II).

Process evaluation

Children’s experiences of the intervention (Paper III) and changes in perceived parental self-efficacy and the moderating effect of change in perceived self-efficacy on the primary outcome zBMI-change (Paper IV) were assessed to inform about possible mechanisms of the process of change.

Children’s experiences

The analysis showed that children enjoyed actively participating in the child-centred dialogue with the nurse and their parent(s) and were given the opportunity to discuss their preferences, views, and interpretations based upon their own understanding (Paper III). The main category was based on 3 generic categories: ‘enjoy participating and influencing in an active and social way’, ‘express their views based on their daily life’, and ‘interpret into an understandable story’.
Participated actively

The children showed that they enjoyed the illustrations used and were interested in and curious about what was said by the nurse. They participated actively as social actors and were eager to give the right answers and tell the nurse what they already knew or what they thought the nurses wanted to hear. They were able to influence their choice to participate and showed when they no longer wanted to participate in the dialogue.

Empowered to express their views

In the dialogue they reflected on their experiences from daily life and were able to tell what they themselves and the body in general liked to eat, drink, and do to promote good health. They could discriminate between healthy and unhealthy choices and seemed to feel empowered by the nurse who questioned, listened actively, responded, and followed the child’s initiatives.

Interpreted health messages into meaningful information

The children reflected on the various health messages and tried to understand their meaning. Some health messages illustrated by the eight illustrations were interpreted differently by the children than the intended meaning created by adults. One example is the illustration of portion size that was designed to help children and their parents to estimate the size of an average child portion by using the size of the child’s hand. As the illustration showed three hands with food directly on the palm of the hand, children interpreted the message that food could be eaten with one’s hands and wondered at the same time how a person could have three hands. They did not remember the message about portion size. Another example is that all children said that water was best for their body and teeth, but interpreted the illustration about sugary drinks with the troll’s happy face as the troll liking all drinks equally. The illustrations about a balanced and varied diet and tooth brushing routines were easily understood health messages, according to the children.

Perceived parental self-efficacy

Table 10 presents the reported scores on parental self-efficacy in promoting diet and physical activity for mother and father separately.

Mothers in the control and the intervention group reported a higher score than fathers in perceived self-efficacy in both promoting a healthy diet and physical activity.

All parents slightly decreased their scores over a 12-month period, except for fathers in the intervention group who slightly increased their perceived self-efficacy in promoting physical activity.
Another observation is that mothers in the intervention group decreased less than mothers in the control group in promoting both diet and physical activity.

The mean difference in change in parental self-efficacy in promoting a healthy diet adjusted for cluster, baseline, CNI, and gender in mothers was 0.37 (95% CI: -0.37 to 1.10; \( p=0.33 \)), while the mean difference in change in parental self-efficacy promoting physical activity in mothers was significant: 0.51 (95% CI: 0.01 to 1.01; \( p=0.046 \)) adjusted for cluster, baseline, gender and CNI of (Table 10). The mean difference in change in parental self-efficacy in fathers in promoting a healthy diet as well as physical activity did not show any statistical differences (Paper IV).

*Perceived parental self-efficacy as a moderator between the intervention and zBMI-change*

Mothers’ change in perceived self-efficacy in promoting a healthy diet seemed to moderate the intervention effect on zBMI-change in children with normal weight, overweight, and obesity (\( \beta=-0.01 \) (95% CI: -0.02 to -0.001; \( p=0.04 \)) (Paper IV).

The secondary sub-analysis of mothers with *increased* perceived self-efficacy in promoting healthy diet showed a significant mean difference in zBMI-change of -0.13 (95% CI: -0.26 to -0.01; \( p=0.04 \); adjusted for cluster, baseline, gender and CNI) in children with normal weight at baseline.

The mean difference in zBMI-change was -0.50 (95% CI: -1.07 to 0.07; \( p=0.08 \); adjusted for cluster, baseline, gender and CNI) in children with overweight or obesity at baseline and hence statistically uncertain (Paper IV).
Table 10. Perceived parental self-efficacy at follow-up in Study B.

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th></th>
<th>Intervention group</th>
<th></th>
<th></th>
<th>Mean difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean ±SD</td>
<td>Mean change</td>
<td>n</td>
<td>Mean ±SD</td>
<td>Mean change</td>
</tr>
<tr>
<td>Mothers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental self-efficacy promoting diet</td>
<td>344</td>
<td>52.3±6.3</td>
<td>-1.0±5.6</td>
<td>473</td>
<td>52.1±6.5</td>
<td>-0.01±6.0</td>
</tr>
<tr>
<td>Parental self-efficacy promoting physical activity</td>
<td>339</td>
<td>23.7±4.5</td>
<td>-0.9±4.2</td>
<td>470</td>
<td>24.0±4.4</td>
<td>-0.1±4.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fathers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental self-efficacy promoting diet</td>
<td>247</td>
<td>48.1±7.9</td>
<td>-0.4±7.5</td>
<td>360</td>
<td>48.1±8.4</td>
<td>-0.3±7.4</td>
</tr>
<tr>
<td>Parental self-efficacy promoting physical activity</td>
<td>246</td>
<td>22.7±5.2</td>
<td>-0.4±4.5</td>
<td>361</td>
<td>22.6±4.7</td>
<td>0.03±4.6</td>
</tr>
</tbody>
</table>

¹Max 60 points; ²Max 30 points; ³p=0.046 with Linear Mixed Model adjusted for cluster, baseline, gender and CNI
Understanding the context

Fidelity to the study protocol as well as perceived knowledge and competence of nurses (Paper II) offered an understanding of the context in which the intervention was situated (Thesis).

Fidelity to the study protocol

According to the child records, the use of illustrations and BMI growth chart was documented in a larger proportion of children with overweight in the intervention group compared to the number of children with overweight in the control group (Table 11).

In intervention group, 214 children with overweight (89.9%) according to the IOTF definitions had documented overweight, compared to 182 children (76.8%) in the control group (Table 11), which was a significant difference ($p=0.0001$).

Regarding the targeted part of CCHD, 61 children (25%) of 238 children with overweight had a documented invitation to the Family Guidance. Parents of 35 children (57%) declined, while parents of 26 children received Family Guidance 1–3 weeks after the 4-year health visit.

A sub-analysis of these 26 children with overweight showed a mean zBMI-change 12 months after the intervention of -0.12±0.46 compared to -0.08±0.52 in all children with overweight in the intervention group (Table 6). The comparison of this subgroup with children with overweight in the control group resulted in a larger mean difference in zBMI-change (MD=-0.16 (95%CI: -0.38 to 0.05; $p=0.13$, adjusted for cluster, baseline, gender and CNI), but no evidence for an intervention effect.

Sixteen families with a 4-year-old child with overweight in the intervention group, born between February and August 2014, had already received Family Guidance when identified with overweight at the age of 2.5 years. As the nurses in the intervention group were trained in CCHD in October–November 2016, some chose to offer the Family Guidance already at the 2.5-year health visits that were scheduled after the training.
Table 11. Delivery of care to children with overweight according to child records.

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th>Intervention group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Universal 4-year health visit</strong></td>
<td>n=237</td>
<td>n=238</td>
</tr>
<tr>
<td>Parent participation <em>(missing)</em></td>
<td>–</td>
<td>6 (2.5)</td>
</tr>
<tr>
<td>one parent</td>
<td>193 (81.4)</td>
<td>184 (77.3)</td>
</tr>
<tr>
<td>two parents</td>
<td>44 (18.6)</td>
<td>48 (20.2)</td>
</tr>
<tr>
<td><strong>Documented measures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used CCHD illustrations</td>
<td>76 (32.1)</td>
<td>130 (54.6)</td>
</tr>
<tr>
<td>Used BMI growth chart</td>
<td>101 (42.6)</td>
<td>182 (76.5)</td>
</tr>
<tr>
<td>Documented overweight</td>
<td>182 (76.8)</td>
<td>214 (89.9)</td>
</tr>
<tr>
<td><strong>Family Guidance at 2.5 years(^1)</strong></td>
<td></td>
<td>16 (6.7)</td>
</tr>
<tr>
<td>Family Guidance offered at 4 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>declined</td>
<td></td>
<td>61 (25.6)</td>
</tr>
<tr>
<td>Accepted</td>
<td></td>
<td>35 (57.4)</td>
</tr>
<tr>
<td><strong>Family Guidance at 4 years(^2)</strong></td>
<td>n=26</td>
<td></td>
</tr>
<tr>
<td>Parent participation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>one parent</td>
<td>12 (46.2)</td>
<td></td>
</tr>
<tr>
<td>two parents</td>
<td>14 (53.8)</td>
<td></td>
</tr>
<tr>
<td><strong>Extra health visits between 4 and 5 years</strong></td>
<td>n=59</td>
<td>n=34</td>
</tr>
<tr>
<td></td>
<td>(no Family Guidance)</td>
<td></td>
</tr>
<tr>
<td>Parent participation <em>(missing)</em></td>
<td>2 (3.4)</td>
<td>4 (11.8)</td>
</tr>
<tr>
<td>one parent</td>
<td>51 (86.4)</td>
<td>27 (79.4)</td>
</tr>
<tr>
<td>two parents</td>
<td>6 (10.2)</td>
<td>3 (8.8)</td>
</tr>
<tr>
<td>Frequency of health visit(s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>one extra health visit</td>
<td>33 (13.9)</td>
<td>30 (12.6)</td>
</tr>
<tr>
<td>two extra health visits(^3)</td>
<td>10 (4.2)</td>
<td>2 (0.8)</td>
</tr>
<tr>
<td>three extra health visits(^4)</td>
<td>2 (0.8)</td>
<td>–</td>
</tr>
<tr>
<td><strong>Total number extra visits(^5)</strong></td>
<td>59 (24.9)</td>
<td>60 (25.1)</td>
</tr>
<tr>
<td><strong>Total accepted referrals</strong></td>
<td>19 (8.0)</td>
<td>11 (4.6)</td>
</tr>
<tr>
<td>Referral offered</td>
<td>41 (17.2)</td>
<td>19 (8.0)</td>
</tr>
<tr>
<td>Declined</td>
<td>22 (53.7)</td>
<td>8 (42.1)</td>
</tr>
<tr>
<td>received care at overweight team(^6)</td>
<td>19 (43.6)</td>
<td>11 (57.9)</td>
</tr>
<tr>
<td>Dietician</td>
<td>12 (63.2)</td>
<td>10 (83.3)</td>
</tr>
<tr>
<td>CHS psychologist</td>
<td>7 (36.8)</td>
<td>–</td>
</tr>
</tbody>
</table>

\(^1\)2.5-year-old child born after training in CCHD; \(^2\)only part of intervention care; \(^3\)number of extra visits × 2; \(^4\)number of extra visits × 3; \(^5\)number of extra visits plus family guidance; \(^6\)the overweight team includes a physician and a specialised nurse or a dietician in Skåne.
Perceived knowledge and competence of nurses

The fidelity questionnaire showed that nurses in the intervention perceived an increase in adequate knowledge of childhood obesity and felt more competent in the communication method compared to the control group. However, in July 2018 only 15 nurses (40.5%) in the intervention group felt comfortable in talking about overweight compared to 13 (34.2%) nurses in the control group (Table 12)

Table 12. Nurses’ perceived knowledge and competence.

<table>
<thead>
<tr>
<th></th>
<th>May 2016¹</th>
<th>December 2017²</th>
<th>July 2018²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline before start (n=171)</td>
<td>Control group (n=40)</td>
<td>Intervention group (n=44)</td>
</tr>
<tr>
<td>Perceived adequate knowledge</td>
<td>95 (55.6)</td>
<td>19 (47.5)</td>
<td>32 (72.7)</td>
</tr>
<tr>
<td>Felt competent in the communication method</td>
<td>61 (28.1)</td>
<td>7 (17.5)</td>
<td>19 (43.2)</td>
</tr>
<tr>
<td>Felt comfortable in talking about overweight</td>
<td>41 (24.0)</td>
<td>8 (20.5)</td>
<td>14 (31.8)</td>
</tr>
<tr>
<td>Did not answer</td>
<td>2 (1.2)</td>
<td>1 (2.5)</td>
<td>2 (4.5)</td>
</tr>
</tbody>
</table>

¹All nurses working in Skåne. ²Nurses in Study B. Data are presented in n (%).
Discussion

The main findings of this thesis, derived from various data-collection methods and analyses, have contributed to a broader and deeper understanding of a multicomponent child-centred obesity prevention intervention targeting 4-year-old children and their families in the Swedish CHS.

Methodological considerations

The overarching strengths and limitations of the Study A and Study B are presented first. Then strengths and limitations are discussed in relation to validity for the quantitative studies, with regard to reliability and validity for the instruments used and in relation to trustworthiness for the qualitative study (Kazdin 2003, Creswell and Creswell 2018).

Strengths and limitations

A strength of this thesis was the use of the MRC framework for the development of a complex multicomponent model that aims to promote a healthy lifestyle in families and prevent obesity in preschool children. Using the framework facilitated translation to ‘real’ routine practice (Craig et al. 2008, Blackwood et al. 2010, Skivington et al. 2021). The intervention was first developed based on previous research and theoretical concepts and tested for feasibility to gather information needed for the planning of a subsequent RCT (Eldridge et al. 2016). The intervention was then tested for effectiveness, but also assessed in a broader process evaluation to better understand mechanisms of change and the context in which the intervention was tested, combining both quantitative and qualitative measures (Skivington et al. 2021). An important contribution was the exploration of children’s experiences of the intervention recognising their right to express their views on matters that concern them (UNCRC, 1989).

Another strength is that Study B included an economic evaluation and accounted for both adverse events and the impact on health inequalities, which is important for policy
makers and funders to be able to decide on further implementation of the intervention (Brown et al. 2019, Skivington et al. 2021).

Testing the intervention in a real-world clinical setting is a strength as it provides useful information about interactions between the intervention and what kind of resources are required to support further implementation (Skivington et al. 2021).

However, due to the setting in routine practice some limitations occurred. Parts of the intervention care, the eight animated illustrations and the BMI growth chart were used in the control group. This diffusion might have led to decreased differences between usual care and intervention care, which could have affected the intervention effect. The nurses in the intervention group were however trained in a structured, step-by-step health dialogue with an explicit theory-based approach, unlike the nurses in the control group (Figure 5). The decline of CHCs in both the control and the intervention group and the withdrawal of children in the intervention group that met a nurse not trained in CCHD decreased the sample size that was needed according to the power calculation. Also, the dependence of health professionals on documenting in the child records about what care children with overweight received might also have affected the findings.

Validity

Internal and external validity are concepts that reflect whether the results of a study are trustworthy and meaningful. While internal validity relates to how well a study is conducted, external validity refers to what extent findings can be generalised or extended to other settings and how results are applicable to the real world (Kazdin 2003, Creswell and Creswell 2018).

Internal validity

Internal validity refers to the extent to which the intervention can be considered to account for the measured effect and which differences between intervention and control group are due to the intervention and not due to other possible alternative explanations (Kazdin 2003). Thus, internal validity depends largely on the study design and how rigorously the study protocol has been followed (Creswell and Creswell 2018).

Study A was designed as a quasi-experimental cluster design. The CHCs were non-randomised, which explains the differences at baseline in $z$BMI and the prevalence of overweight and underweight. To increase internal validity and decrease selection bias, children in the intervention group were compared to three times as many children in the control group and the CHCs were matched considering CNI and setting in a rural location. The CHCs that executed intervention care were closely monitored through regular meetings between the research group and nurses. All children were followed
prospectively from baseline to follow-up with case reports indicating what care they had received. The data of children at the CHCs who received usual care were collected retrospectively at the age of five. What care they had received at the 4-year health visit was not monitored. The chance that nurses at the eight ‘control’ CHCs used the illustrations or the BMI growth chart as tools to promote a healthy lifestyle during the universal 4-year health visit was considered minor based on the outcomes of the fidelity questionnaire in May 2016 (Paper I).

Study B was designed as a cluster randomised controlled trial with a long-term follow-up of one year and a large number of participants, which is generally acknowledged as powerful tools in assessing effectiveness in healthcare interventions (Blackwood et al. 2010). Randomisation through equal allocation is a way to get similar baseline characteristics and reduce selection bias (Blackwood et al. 2010). To equally distribute socioeconomic baseline characteristics the CHCs were stratified in two different strata prior to randomisation. One stratum contained CHCs where parents with a lower socioeconomic status and the second stratum contained CHCs with parents with a higher socioeconomic status. The proportion of children with a lower socioeconomic status was slightly higher in the control group compared to the intervention group (Table 2). One reason might be that a majority of nurses who stopped working in the intervention group came from CHCs with CNI≥0.93. Another reason might be that 10 CHCs with CNI≥0.93 were randomised as ‘control’ CHCs, while 9 were ‘intervention’ CHCs. Among children whose parents answered the survey a similar inequality in CNI was observed. Fathers in the control group, however, were better educated than fathers in the intervention group (Table 3). Since differences in CNI at baseline threatened internal validity, all outcomes were adjusted for CNI.

Study B used cluster randomisation on the level of CHC. Randomisation on individual level was not feasible, because of the high risk of crossover contamination (Campbell et al. 2000, Higgins 2021). The clusters were recruited before stratification and randomisation, which reduced selection bias (Brown et al. 2019). As participants within a cluster tend to respond in a similar way, the effect of clustering had to be considered to avoid false narrow confidence intervals (Higgins 2021), and all outcomes were adjusted for clustering effects in the statistical analysis. Because clustering effects were not considered in the power calculations, the sample size might have been too small to be able to detect a mean difference in the primary outcome zBMI-change.

To increase internal validity, nurses’ fidelity to the study protocol in children with overweight was monitored by collecting data from the child records (Paper II). That only 26 children of 238 children with overweight received Family Guidance 1–3 weeks after the 4-year health visit has to be considered when assessing the primary outcome for children with overweight (Table 11). The size of the effect might have been larger in the intervention group if more children with overweight had participated in
the Family Guidance, especially since the sub-analysis of these 26 children who did receive Family Guidance showed a larger decrease in zBMI-change at follow-up.

**External validity**

External validity refers to how results can be generalised or transferred to other populations or settings (Kazdin 2003, Creswell and Creswell 2018). One way to improve external validity is to replicate and conduct a study in another setting with a different sample and see if the same results can be reproduced. In this way, the MRC framework, developing an intervention based on evidence increases external validity.

The salutogenic family therapeutic solution-focused approach used in CCHD is derived from SOFT, which was tested regarding the degree of obesity, physical fitness, self-esteem, and family functioning and showed positive effects (Nowicka et al. 2007, Nowicka and Flodmark 2011). SOFT is based on systemic theory and uses family interactions to help support the implementation and maintenance of lifestyle changes (De Shazer et al. 1986). Efforts that promote a healthy lifestyle and prevent obesity at an early age with the involvement of parents are likely to have optimal effects (Brown et al. 2019).

Because the CCHD approach is theory-based and uses illustrations that not only focus on healthy diet and physical activity, but also on routines such as tooth brushing and bedtime routines, CCHD could be tested in other settings such as preventive dental care for preschool children and in preschool. Also, the targeted Family Guidance could be offered to families in which other unhealthy lifestyles than overweight are identified.

As the intervention was tested in the real-life setting and provided knowledge which otherwise would not have been discovered, the external validity can be considered high. That only 26 children with overweight were offered Family Guidance decreased the internal validity, but offered an insight into the complexity of real-life routine practice (Kazdin 2003). Another lesson learnt was that nurses working within CHS changed workplaces, which implies that training in the model has to be recurrent when implemented on a larger scale so that even newly recruited nurses can be trained in the method.

External validity was threatened by the fact that part of Study B data collection was via surveys sent to parents by nurses in both groups. The surveys were only in Swedish and only parents who could read and write Swedish could answer. The response rate of 24.8% in parents of children in the control group compared to 28.5% in the intervention group can be considered low. At follow-up, another 24.7% of mothers and 28.4% of fathers in the control group compared to 28.1% of mothers and 31.1% of fathers were lost to follow-up.

Parents of children that were not invited by nurses to answer the surveys had a higher prevalence of overweight and obesity in both groups than those children whose parents did receive the surveys. Background information about the children that were not
invited to the study and on children whose parents did not answer the surveys can help interpret the generalisability of the findings. Parents not invited to respond to the surveys, probably because of insufficient skills in Swedish, had a higher proportion of parents with CNI≥0.93. The proportion of parents with a lower socioeconomic status that did not respond was comparable with the parents that did answer. However, parents that responded to the survey were better educated than the general Swedish population aged 25–64. Among the responders 76% of mothers and 62% of fathers had a university degree (Table 3), while in 2020, in the general population in Sweden, 35% of females aged 25–64 years had at least three-year post-secondary education compared to 23% of males (Statistics Sweden 2021).

Another limitation is that only one survey in Study B was answered by two parents of the same sex. One reason could be that the surveys were labelled as ‘to the mother’, ‘to the father’ and ‘to another caregiver’. A number of same-sex families contacted the author of this thesis and chose not to respond to the survey, because they wished to be addressed as ‘parent’. This information is important for future studies. The number of fathers that participated is however much larger than in most studies that evaluate child obesity family-based interventions, which strengthens external validity (Davison et al. 2018).

Another factor that might have limited the external validity is that the study was situated in the Swedish setting where CHS is free of charge, attended by nearly all children aged 0–6 and guided by the Swedish CHP, including 18 universal health visits. This means that a low-intensive intervention like CCHD builds on an already existing trustful relationship between the nurse and the family. Even in other countries that offer universal CHS with regular visits over time and targeted services for families with additional needs, an intervention that focuses on protective factors could be a more effective way to engage parents in obesity prevention (McPherson et al. 2017, Bohnert et al. 2020).

**Reliability and validity of the instruments used**

Reliability refers to the ability of an instrument to measure consistently (Tavakol and Dennick 2011, Taber 2018). Validity refers to the extent to which the instrument fits its purpose and measures what it is intended to measure (Kazdin 2003). An instrument is assumed to be reliable when multiple testing shows stable results and high internal consistency (Creswell and Creswell 2018). Both the CFQ and PSEPAD used in Study B are frequently used and validated instruments (Birch et al. 2001, Nowicka et al. 2014, Bohman et al. 2016, Parekh et al. 2018, Camfferman et al. 2019).

As it is important to identify aspects that could negatively impact the target group in evaluations of childhood obesity prevention programmes, especially when targeting young children (Waters et al. 2011, Landgren et al. 2020), CFQ was included to
measure parental restrictive feeding practices and concerns about the child eating and overweight (Ek et al. 2016). Factors A and B of the PSEPAD were considered relevant as self-efficacy is one of the theoretical concepts of the intervention and as CCHD focused on promoting health diet and physical activity in both children and their parents.

To objectively measure the reliability of the instruments Cronbach’s alpha was used and described under data collection. Cronbach’s alpha describes internal consistency in a particular instrument and measures how closely related a set of items in an instrument are in a certain factor (Taber 2018). Commonly acceptable values for Cronbach’s alpha are between 0.70 and 0.95; a value above 0.90 might indicate overlapping of items and assumes that the number of items might be reduced (Tavakol and Dennick 2011).

HLQ was chosen because it focused on healthy behaviours and family routines instead of on unhealthy behaviours and was found well fitted in the Swedish setting (Köhler et al. 2017). The items about hours spend on physical activity and sedentary behaviour had to be excluded as the hours answered by parents could be interpreted as hours per week or hours per day. A proper validation of the question might have discovered the unclear formulation of the question. Because of the use of only single items, internal consistency was not tested.

**Trustworthiness**

In qualitative studies trustworthiness is discussed regarding credibility, dependability, confirmability and transferability (Elo et al. 2014). Trustworthiness should be assessed during the entire analytic process so that readers of the study can clearly follow how the findings were created (Elo et al. 2014).

**Credibility**

To establish credibility the choice of participants must be described accurately (Elo et al. 2014). Another way is to clearly report the selection of methods used and the description of the analytic process (Lincoln and Guba 1985).

Combining non-participants observations and interviews was a suitable method to gather both verbally and non-verbally experiences from 4-year-old children that could answer the research question (Flick 2007, Elo et al. 2014). Data triangulation was especially useful as 4-year-old children have different ways to communicate (Nilsson et al. 2015). Some children were more talkative whereas others used drawings or gestures to communicate. To promote gathering of rich data, the children were interviewed in the presence of their parent(s) in a place of their choice. Using the memory game, the puppet, the illustrations, the story book and drawings was another way.
Content analysis was chosen because existing research in this area was limited and an unprejudiced approach to obtain an understanding of children’s experiences was necessary (Elo and Kyngäs 2008, Krippendorff 2019). Content analysis as a research method helped to systematically analyse the data, looking for similarities and differences and to abstract the data obtained from specific observations and meaning units into a larger general statement (Krippendorff 2019). In this process it was important to move back and forth, discussing labelling into codes, checking the credibility of the categories, and reflecting on the interpretation of the findings (Elo and Kyngäs 2008, Krippendorff 2019).

A challenge concerning credibility was that the researchers, being adults, had to be attentive and sensitive to explore and describe the data from the child’s point of view during the entire research process to be able to truly capture the child’s perspective (Söderbäck 2010).

**Dependability**

Dependability relates to stability of data over time and under varying conditions (Elo et al. 2014). A thematic interview guide was used with open-ended questions to make sure that all topics were reflected upon (Appendix 1). Making field notes was another way to enhance data exploration. The author of this thesis conducted the primary analysis of the qualitative study, but had a continuous discussion with the co-authors of Paper III to reach consensus on the sub-categories and generic categories. The main category was formulated after a discussion of the preliminary results with fellow researchers in the field of child and family health.

**Conformability**

The term confirmability refers to the objectivity of the data and interpretation (Elo et al. 2014). To promote objectivity and increase transparency all generic categories were supported by quotations from the individual observations and interviews and by an overview of the analytic process for the generic category ‘interpret into an understandable story’ (Paper III). Describing preunderstanding to facilitate reflection on possible bias also strengthens confirmability (Nyström and Dahlberg 2001).

**Transferability**

Transferability refers to the potential for transfer of findings to other settings than the one studied (Elo et al. 2014). To facilitate transferability the context, participants, data collection, and process of analysis were clearly described (Elo and Kyngäs 2008). The study was carried out in Sweden where CHS might be differently organised than in other countries. However, health promotion activities for families with preschool children are provided worldwide and the findings on how children understand and interpret health information might therefore be transferable to a broader context.
General discussion of the findings

This general discussion starts by discussing the impact of the intervention, reflections on the interaction with parents and nurses, and its cost-effectiveness. Then it discusses strengthening child participation and health literacy and increasing perceived parental self-efficacy as possible mechanisms for how the intervention worked.

**Impact of the intervention**

The feasibility study showed that both the universal and the targeted part of CCHD were feasible in CHS and that fewer normal weight children in the intervention group developed overweight and none obesity 12 months after CCHD.

In the RCT, CCHD did not show any intervention effect on the primary outcome zBMI-change 12 months after the intervention in children with normal weight, nor on the secondary outcome BMI-change. In children with overweight a tendency to an intervention effect on both zBMI-change and BMI-change was suggested, albeit statistically uncertain due to wide confidence intervals. CCHD did not cause any adverse events. There was a favourable tendency to decreased prevalence of obesity in children with overweight 12 months after the intervention and no children developed underweight.

That intervention effects on BMI in prevention interventions are hard to detect is illustrated by a systematic review of family-based interventions in the primary care setting for children aged 2–6 that showed that only four out of 12 studies had a reducing effect on BMI (Landgren, Quaye et al. 2020). Of these four, there was only one study with a long-term follow-up of 12 months (Slusser et al. 2012). This non-randomised study evaluated an intensive intervention of many weekly sessions, which is not feasible in the primary care setting (Sim et al. 2016). Two other RCTs testing family-based interventions in the health care sector in children aged 2–6 years with normal weight and overweight, did not affect zBMI at the 2-year follow-up (Rifas-Shiman et al. 2017, Sherwood et al. 2019).

A positive observation is that CCHD did not appear to increase health inequalities regarding socioeconomic status, in contrast to another RCT that compared usual care with five motivational interviewing sessions during a one-year period with mothers of overweight children (Broccoli et al. 2020). Children with overweight whose mothers were low-educated showed an increase in BMI one year after the intervention, while children with high-educated mothers decreased in BMI. The authors suggested low health literacy as an explanation for the lack of effect in mothers with low education as motivational interviewing is a verbal tool (Broccoli et al. 2020).
Use of illustrations and the BMI growth chart that strengthen health literacy might have contributed to the fact that CCHD did not have a negative impact on children with overweight in families with a lower socioeconomic status.

Some advocate that the effectiveness of an intervention in the primary care setting should not be defined only by the reduction in BMI, as families might have made unmeasured positive changes in their child’s lifestyle that might have a lifelong influence (Armstrong and Skinner 2016).

In this way, a positive finding is that a significantly larger number of children with overweight in the intervention group were documented with overweight in comparison to the control group. A Swedish study within the CHS concluded that nurses did not always bring up concerns about the child’s overweight, for fear that this would compromise the trustful relationship they had built up over many years (Sjunnestrand et al. 2019).

The training in CCHD and the reflective tutorial sessions with special focus on the challenges when a child was identified with overweight might have contributed to the improvement of identification of children with overweight. Raising concerns about the child’s rising trend in BMI can help parents to better understand the importance of establishing and maintaining a healthy lifestyle (Brown and Perrin 2018).

**Delivery of CCHD, a balancing act**

One quarter of the families with children with overweight were offered Family Guidance. Some families had already been offered Family Guidance at the 2.5-year health visit and some had not been documented with overweight. Of the families who had been offered Family Guidance more than half had declined the offer. To better understand these findings, it is important to discuss studies that are situated in the context and explored experiences of two key stakeholders in the intervention: parents receiving the intervention and health professionals implementing it.

**Understanding the context of the parents**

First of all, CCHD is designed as a step-by-step intervention according to the needs of the family, but is also based on trust and partnership to promote child health. The targeted part of CCHD, Family Guidance is an extra visit offered to the entire family and builds upon the neutral and non-blaming discussion started during the universal 4-year health visit. Parents are thus offered the choice to receive Family Guidance, which is in line with previous research that showed that compulsory care without choice might not contribute to the establishment of sustainable healthy behaviours (Carr and Epstein 2020)
Some parents might have declined the offer as they felt the universal part of CCHD had been sufficient guidance to increase motivation to engage in healthy lifestyle and establish small changes (Dawson et al. 2014, Armstrong and Skinner 2016, Brown and Perrin 2018). Parents who received CCHD in Study A experienced the dialogue as reflective and non-judgemental, with a focus on healthy behaviours and normalisation of the child’s eating, diminishing worries and increasing responsiveness to child satiety signals (Håkansson et al. 2019).

Parents felt trust in discussing their concerns with the CHS nurse and were impressed by the child’s knowledge of healthy behaviours. Parents asked for tailored professional guidance in how to maintain a healthy lifestyle in their everyday life and wished to take home the CCHD’s easy-to-understand illustrations for further discussion with other family members (Håkansson et al. 2019). This request resulted in a storybook containing CCHD illustrations that was given to all children in Study B.

A study exploring how parents experienced CCHD, when overweight was identified could contribute to a better understanding and is ongoing. Nurses who performed CCHD described how parents responded emotionally when overweight was identified (Castor et al. 2020). Some parents felt relieved when the child’s overweight was brought up and asked for support and guidance, while others reacted with anger and frustration and refused additional support (Castor et al. 2020).

Other studies reported that some parents found it difficult to believe that their child had overweight and dismissed the message (Gillison et al. 2014, Gainsbury and Dowling 2018). Other parents believed that they themselves did not need additional support, but considered other parents living in another context in need of additional support (Gainsbury and Dowling 2018). Another reason might be parents’ lack of self-efficacy to motivate their children to a healthy lifestyle (Gillison et al. 2014).

Parents could also feel worried that their child would get stigmatised and not wish to discuss the topic in the presence of the child (Ames et al. 2020). Concerns of stigmatising are essential as many parents might have experienced the stigma of obesity themselves and want to shield their children from these experiences (McPherson et al. 2017).

However, as CCHD is based on CCC and emphasises the child’s right as an active agent in its own care, it is important to also involve the child in cooperation with its parents in the discussion about weight. Other studies show that it is possible to successfully include children in cooperation with their parents in dialogues on serious health-related issues (Jalmsell et al. 2015, Sisk et al. 2016).
The context of health professionals

Nurses trained in CCHD felt more knowledgeable about child overweight and more competent in the communication method, but nearly two years after their training only 40% of the nurses in the intervention group felt comfortable communicating about overweight.

In this way, it is important also to discuss the low numbers of Family Guidance from the health professional perspective. Nurses providing CCHD described a balancing act in how and when to raise the issue of overweight. On the one hand they felt responsible to support the child and the family towards a healthier lifestyle, but on the other hand they wanted to be receptive to the perceived needs of the child and the family (Castor et al. 2020). That parental receptiveness and the family-professional relationship can influence how care is provided has been described in many studies that explored or reviewed health professionals’ experiences of discussing weight with children and their families (Laws et al. 2015, Dera-de Bie et al. 2016, Sjunnestrand et al. 2019, Abdin et al. 2021).

One way to facilitate a legitimate opening to a dialogue on sensitive topics such as lifestyle and weight is to use positively framed messages or the BMI growth chart (Laws et al. 2015). Nurses who used CCHD described the illustrations as a structured and neutral way to introduce the topic of healthy lifestyle and family routines. Because the illustrations focused on several positive behaviours that benefit health, nurses felt they could tailor the dialogue to the family’s needs (Brattwall-Eilert and Tysk 2018).

The interactive illustrations helped nurses to explore the context in which the child and the family lived and to reflect on the family’s general knowledge, solutions, and prior experiences of changing lifestyle (Brattwall-Eilert and Tysk 2018, Castor et al. 2020). The nurses experienced that the illustrations established a more equal relationship between the family and the health professionals which increased the opportunity to achieve empowerment (Brattwall-Eilert and Tysk 2018).

In CCHD, nurses were trained to print the BMI chart and draw the natural decreasing trend and the following normative rise in BMI (Figure 7). Nurses felt that the BMI growth chart was an objective and professional tool to discuss trends in BMI over time with the parents (Castor, Derwig et al. 2020). Parents’ understanding of normative growth can be promoted by observing trends over time and reassuring healthy growth, especially in parents with low numeracy skills (Oettinger et al. 2009, Regber et al. 2013b, Brown and Perrin 2018, Bohnert et al. 2020). The physiological decrease in BMI between the age of 1 and 5 years often worries parents as they are concerned their child is developing underweight (Regber et al. 2013a, Brown and Perrin 2018).
Study A showed that the tutorial sessions strengthened nurses’ confidence in the structured CCHD model (Paper I). The tutorial sessions were used to actively discuss and reflect on nurses’ experiences of CCHD and were set as an example of how to start the reflective process in the health dialogues and Family Guidance in routine practice.

Training in CCHD increased nurses’ professionalism and gave them a structured model and tools (Castor et al. 2020). Offering health professionals continuous training in communication skills has been suggested as a way to improve communication in weight related issues with children and parents (Laws et al. 2015, Sjunnestrand et al. 2019, Abdin et al. 2021). The recurrent tutorial sessions provided nurses in the CHS with skills and increased their self-esteem in starting a discussion about weight (Castor et al. 2020). Because the majority of nurses in the intervention group still felt uncomfortable communicating about overweight, there is a need for continuous training, frequent practice, and reflective feedback (Carcone et al. 2016).

**Costs and cost-effectiveness**

The economic evaluation, assessed from the societal perspective, showed that the delivery of care for children with overweight in the intervention with less referrals and excessive visits, cost less than delivery of care in the control group. The nurses in the control group offered twice as many referrals when overweight was identified, while half of them were declined by the parents.

Studies have described how health professionals lacking training and guidelines offer unnecessary visits or referrals (Isma et al. 2013, Bontje et al. 2021), resulting in higher costs for delivery of care. That CCHD would cost less was expected as it was assumed that health professionals trusted by the families and provided with knowledge of child obesity as well as a structured model and tools would offer Family Guidance, but fewer extra visits and referrals. The low use of Family Guidance was however unexpected.

To estimate whether CCHD was cost-effective the incremental costs were compared to an Australian study that estimated how much reduction in zBMI would save in health care costs in children aged 2–5 years. They presented a number of thresholds that effective interventions could cost per child of the Australian population aged 2–5 years to be considered cost-effective (Brown, V et al. 2019). Comparing the incremental costs for CCHD in children with overweight, estimated at 167 euros per child with these thresholds, it is suggested that CCHD is cost-effective, since the incremental costs of CCHD were lower than the lowest threshold in the Australian study (Brown, V et al. 2019).
It was difficult to compare the ICER of the present study with other economic evaluations of interventions for children aged 0–5 years as they vary in terms of intervention intensity, the age of the children and settings (Frew 2016, Döring et al. 2018, Brown et al. 2020).

For comparability with other health-care interventions, it would have been desirable to add a health-related quality-of-life measure as an indicator of effectiveness. In children aged 2–5 years valid instruments to measure child-related quality of life are however lacking and the use of BMI is recommended (Döring et al. 2016).

**Strengthening the child’s participation and health literacy**

In the present study, 4-year-old children participated as social actors in the interactive dialogue on healthy lifestyle and were competent in making health information meaningful. They seemed to enjoy actively participating and reflected on the health messages building on their own experience and understanding, as described by others (Freeman 2015, Fairbrother et al. 2016, Wiseman et al. 2018).

The children recognised basic health concepts and seemed to be health-conscious, which is in line with the view that children can take an active role in their health from an early age (Velardo and Drummond 2016, Bröder et al. 2017). It is also consistent with UNCRC, which has been incorporated in the Swedish Act since 2020 (UNICEF 1989, Swedish Government 2018).

Recognising the child as a social actor is thought to increase children’s ability to be health-literate (Bröder et al. 2019). The participatory and reflective process in CCHD is believed to enable children’s and parents’ active engagement in health promotion activities and strengthen their health literacy. This is corroborated by a recent systematic review that concluded that health literacy interventions are likely to be successful when they are multicomponent, theory-based, tailored, and focus on active discussions to increase a person’s self-efficacy (Stormacq et al. 2020). To further strengthen child health literacy the involvement of the family and the child’s social network as social role models is important as children’s health literacy skills are strongly influenced by the context they live in (Nutbeam 2017, Bröder et al. 2019).

The children guided by the attentive nurses reflected on the meaning of the health messages and interpreted some of illustrations differently than the intended meaning. In this way, the children showed that they were able to critically analyse the relevance of the information and practices their health literacy (Nutbeam 2000).

This finding is important for the development of future child-centred interventions. As for CCHD, children’s reflections on the illustrations have been used in a recent revision in collaboration with 3- to 5-year-old children from a preschool in Skåne (Appendix 4).
The findings also imply that it is necessary to include the child’s perspective in research and involve children as stakeholders in the development and evaluation of health promotion activities (Stålberg et al. 2016, Murphy et al. 2021).

**Parental perceived self-efficacy a mechanism for the process of change**

The intervention showed a minor effect on mothers’ change in perceived self-efficacy in promoting physical activity. Mothers’ perceived self-efficacy scores in promoting a healthy diet and fathers’ perceived self-efficacy scores in promoting physical activity also showed minor favourable trends 12 months after the intervention in comparison to the control group, but no significant differences.

Mothers’ mean scores in perceived parental self-efficacy in promoting a healthy diet and physical activity in the present study were in the same range as three Swedish cross-sectional studies that used the same survey (Parekh et al. 2018, Rohde et al. 2018, Döring et al. 2021). The scores can be considered high, which makes it hard to detect improvements if the measure is not sensitive enough (Döring et al. 2021).

Fathers’ mean scores were significantly lower than mothers’ in promoting both a healthy diet and physical activity in both the control and the intervention group. Studies that measured fathers’ perceived parental self-efficacy with the same or a similar instrument are lacking.

Overall, there is low father participation in family-based interventions for child obesity (Davison et al. 2018) and studies that highlight the positive role of fathers in the promotion of healthy behaviours in small children are scarce (Wong et al. 2017, Davison et al. 2018). Some researchers advocate that an active role for fathers and the inclusion of both parents in childhood obesity programmes might strengthen intervention effects, especially for boys (Sherwood et al. 2019).

A promising finding in CCHD is that children with overweight who received the Family Guidance with both parents present in 54% of them had a larger decrease in zBMI (Table 11). This might be an indication that CCHD’s salutogenic family-therapeutic solution-focused approach supports fathers’ participation by engaging the entire family in a non-judgemental dialogue about the child’s health and might be an effective way to prevent childhood obesity.

The moderating effect of perceived parental self-efficacy on zBMI-change in children with normal weight, overweight, and obesity was found significant in maternal perceived self-efficacy in promoting a healthy diet. A subsequent sub-analysis of zBMI-change in mothers with *increased* perceived parental self-efficacy found a significant intervention effect in children with normal weight 12 months after the intervention and a favourable tendency of zBMI in children with overweight or obesity.
Although subgroup analysis results should be interpreted with caution (Freemantle 2001, Moyé 2015), these findings might help us to better understand how the intervention works and could make it possible to tailor intervention strategies for different subgroups. This subgroup analysis suggests that CCHD might be more effective in mothers who have the potential to increase their self-efficacy, and measuring self-efficacy before the intervention might help to identify these mothers (Alulis and Grabowski 2017).

Perceived parental self-efficacy has been suggested as an important mechanism for encouraging behavioural change in preschool children (Albanese et al. 2019, Enright et al. 2020). Higher levels of self-efficacy beliefs in parents are associated with a larger extent of healthful behaviours such as higher levels of physical activity and adequate fruit and vegetable intake in children (Ice et al. 2014, Parekh et al. 2018, Rohde et al. 2018).
This thesis showed that a theory-based intervention tested in real life for the prevention of obesity is feasible in CHS and cost-effective, with a decreasing tendency in zBMI in children with overweight. The child-centred intervention facilitated the active participation of 4-year-old children in the context of their families and recognised them as social actors in a health dialogue that promotes health. That a significantly larger number of children were documented with overweight is an important finding, as early identification of children with overweight and raising awareness are important steps in preventing childhood obesity (Brown and Perrin 2018, Sjunnestrand et al. 2019).

The possible link between a favourable development in zBMI and increased maternal perceived self-efficacy in promoting a healthy diet suggests that the family-based approach of CCHD might have supported family members to engage in health-protective processes. It is important to note that the intervention did not cause any adverse events and that health inequalities concerning gender and socioeconomic status were not widened, especially because the intervention was performed in CHS, which reaches nearly all families, regardless of their socioeconomic status (NBHW 2014).

After the training in the structured model and the recurrent reflective tutorial sessions, health professionals felt more knowledgeable about child overweight and more competent in the communication method. That a majority of the nurses still felt uncomfortable communicating about overweight illustrates the need for continuous training (Bradbury et al. 2018, Sjunnestrand et al. 2019, Uy et al. 2019).

CCHD has the potential to be implemented universally in the CHS, especially if started earlier, engaging parents in a reflective dialogue that focuses on a healthy lifestyle and family routines and uses tools that strengthen the child and the family’s health literacy.

If only parts of CCHD are to be implemented in real-life routine practice, the following core intervention components should be contained (Skivington et al. 2021):

- Theory-based: child-centred, health literacy and parental self-efficacy
- Stepwise structured and based on protective factors
- The CCHD approach, dialogue, and tools
- Recurrent training in reflective dialogue and the complexity of obesity.
Within the field of childhood obesity prevention there is a growing opinion that there is the need for a whole system response to address childhood obesity and its complexity (Rutter et al. 2017, Narzisi and Simons 2021). Hence, they question the effectiveness of interventions that only focus on changing family behaviours, sometimes called ‘downstream’ initiatives, and stress the need for ‘upstream’ initiatives that influence the society and the environment to tackle childhood obesity (Rutter et al. 2017, Nobles et al. 2021). They suggest that interventions on the individual level should remain, but that these should be combined with structural measures in society, such as health policies and legislation.

Future research could focus on how CCHD with its salutogenic family-therapeutic solution-focused approach could be combined with other ‘upstream’ initiatives that promote a healthy environment or with other sectors such as the child care setting or child dental care.

Health professionals could continue to support children and their families to reflect on the health-promoting strengths and resources they already have, while public health actions could provide a healthy environment in which healthy choices are easier to make (Hendriks et al. 2012). ‘Health in the river of life’, a metaphor frequently used in the salutogenic theory of health, illustrates how health professionals encourage families to identify protective factors and improve their options for health and life (Eriksson and Lindström 2008), while a fence obstructs ‘upstream’ factors that might impede a healthy weight development (Figure 9).

Such research should preferably use a community-based participatory research approach that recognises the community as a collaborative partner and tries to improve the lives of the members of that community, attending to social inequalities (Berge et al. 2016). In this way, tools and illustrations could be based on the needs and health literacy level of the children and families in an attempt to increase parental engagement and the credibility of the tools used for the prevention of obesity.

How 4-year-old children experience the discussion about weight has not yet been studied, but is also important as parents and health professionals find it challenging to discuss overweight in the presence of the child (Ames et al. 2020, Castor et al. 2020).
Figure 9. Health professionals encourage families to swim in ‘the river of life’, while health policies and legislation hinder upstream risk factors from entering
Populärvetenskaplig sammanfattning


Det övergripande syftet med denna avhandling var att utveckla en evidensbaserad och barncentrerad samtalsmodell som kan användas inom barnhälsovården för att främja hälsosamma levnadsvanor och förebygga obesitas. Avhandlingsarbetet utgick från ett metodologiskt ramverk för att utveckla komplexa interventioner i hälso- och sjukvård.

En strukturerad samtalsmodell “Grunda Sunda Vanors barncentrerade hälsosamtal” utvecklades baserad på en systematisk genomgång av tidigare forskning och med teoretisk utgångspunkt i barncentrerad vård, i hälsolitteracitet och i föräldrars tillit till sin förmåga att främja hälsosamma levnadsvanor hos sitt barn. Samtalsmodellen består av två delar: 1) ett universellt barncentrerat hälsosamtal som utgår från ett interaktivt bildmaterial med de viktigaste levnadsvanor som påverkar barns viktutveckling och barnets BMI-kurva vid barnets 4-årsbesök på barnavårdscentralen (BVC) och 2) ett riktat vägledande familjesamtal för familjer där ett barn identifierats med övervikt eller obesitas. Sjuksköterskor fick en dags utbildning och återkommande reflektierande handledningstillfällen för att tillägna sig hälsosamtalets förhållningssätt, struktur och verktyg.


I en klusterrandomiserad kontrollerad studie som inkluderade barn med normal vikt och övervikt utvärderades samtalsmodellens effekt på standardiserat BMI (standardiserat utifrån barnets ålder och kön) i jämförelse med traditionell vård samt kostnader och kostnadseffektivitet analyserades. Totalt 6 047 fyraåriga barn, varav 4 598 barn med normalvikt och 490 barn med övervikt, deltog vid 35 BVC. Vid uppföljning ett år efter 4-årsbesöket sågs ingen effekt på standardiserat BMI för barn med normalvikt.

De uppskattade kostnaderna för barn med övervikt, beräknade ur ett samhälls perspektiv, var lägre för barn som erhöll den nya samtalsmodellen än kostnaderna för barn med övervikt som fick traditionell vård, vilket framförallt kan förklaras av skillnader i antal remisser till andra vårdgivare. Sjukskötterskorna som var utbildade i den nya samtalsmodellen kände sig mer kunniga i barnövervikt och mer kompetenta i kommunikationsmetoden.

Observationer och intervjuer med 21 barn som fick det barncentrJerade hälsosamtalet visade att barn ville delta aktivt som sociala aktörer i hälsosamtalet. Barnen uttryckte upplevelser från sin vardag och ville förstå innebörden av hälsobudskapet. Resultatet visade att barnen ibland tolkade hälsoinformationen på bilderna på ett annat sätt än vad som avsågs.

Föräldrar till 1 197 barn, 1 115 mödrar och 869 fäder, svarade på enkäter om tilltro till sin förmåga att främja hälsosamma levnadsvanor för sitt barn. Mödrar som hade fått erfarenhet av den nya samtalsmodellen visade en svag positiv utveckling i upplevd tilltro till sin förmåga att främja fysisk aktivitet till sina barn i jämförelse med mödrar som hade fått traditionell vård. Hos mödrar med ökad upplevd tilltro till sin förmåga att främja hälsosamma matvanor ett år efter samtalet fanns en gynnsam utveckling av barnens standardiserade BMI, framförallt hos barn med normal vikt, men det fanns även en positiv tendens dock statistiskt osäker bland barn med övervikt eller obesitas. Föräldrarnas tilltro tidigare i samhället kunde vara delaktiga i hälsosamtalet och tolka kritiskt hälsoinformationen utifrån sina egna tankar och upplevelser. Avhandlingsarbetet styrker vikten av att respektera barn som sociala aktörer i sitt sammanhang och att inkludera barnets perspektiv i forskning samt betydelsen av att använda bildmaterial som stärker barnets och familjens hälsolitteracitet.


Barnen kunde vara delaktiga i hälsosamtalet och tolka kritiskt hälsoinformationen utifrån sina egna tankar och upplevelser. Avhandlingsarbetet styrker vikten av att respektera barn som sociala aktörer i sitt sammanhang och att inkludera barnets perspektiv i forskning samt betydelsen av att använda bildmaterial som stärker barnets och familjens hälsolitteracitet.

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”Barns upplevelser av Grunda Sunda Vanor”

Intervjuguide

Tematisk semistrukturerad intervjuguide med möjliga frågor att ställa till barn i närvaro av sina föräldrar.

Syftet med intervjuerna:

Att beskriva barns upplevelser av Grunda Sunda Vanors hälsovård vid 4 års hälsovård på BVC utifrån barnets perspektiv.


Före intervjuerna kommer Barnet och föräldrar att informeras om:

- Syftet med studien
- Att det inte finns några rätt eller fel svar
- Att det finns olika upplevelser och erfarenheter
- Att de kan välja att inte svara på alla frågor om de känner sig obekväma att svara och att inte de behöver ange några skäl för att inte svara
- Att intervjuer kommer att spelas in om så tillåts
- Att alla uppgifter behandlas konfidentiellt och inte förs vidare
- Att intervjun kommer att pågå så länge de önskar men vanligtvis inte längre än en halv timme
"Barns upplevelser av Grunda Sunda Vanor"

Intervjuguide

- Hej! *Namn barnet*
- Känner du igen mig? Det är jag, Trollet. Vi sågs på BVC för en vecka/ par dagar sedan
- Jag fanns med på bilder om mat och rörelse, tänder eller sömn (beroende på vilka bilder som används vid barnets 4 års hälsobesök)
- Kom du ihåg vad jag berättade?
- Kan du berätta vad vi pratade om?
- **Följfrågor**
  o Kan du berätta mer?
  o Vad tyckte du om samtalet? Vad tyckte du var svårt, enkelt, roligt, tråkigt?
  o Jag fanns också med i en liten bok, har du läst boken?
  o Kan du berätta vad som stod i boken?
- **Följfrågor**
  o Kan du berätta mer?
  o Vad tyckte du om boken? Vad tyckte du var roligt, tråkigt?
  o Visade du boken för någon annan?
  o Vad tror du kroppen mår bra av?
  o Vad gillar din kropp att göra, leka, äta, dricka?
  o Kan du berätta mer?
  o Kan du ge exempel?

**Bildmaterial**

Jag tänkte visa bilderna som jag är med på och undra om du kan berätta lite om bilderna? (ta fram bilderna som användes vid barnets 4 års hälsobesök)

- Varför tycker du det är bra att äta frukt och grönsaker?
- Varför tycker du det är bra att äta olika sortens mat?
- Varför tycker du det är bra att äta en hand av varje?
- Varför tycker du det är bra att dricka vatten?
- Varför tycker du det är bra att borsta dina tänder?
- Varför tycker du det är bra att leka och röra på sig?
- Varför tycker du det är bra att sova?
- **Följfrågor**
  o Berätta mer
  o Kan du ge exempel?
  o Vad menar du?

- Finns det några andra saker som du skulle vilja prata om?
Information till barn om studie

"Barns upplevelser av Grunda Sunda Vanor"

Hej

Snart är det dags för dig att komma till BVC.

På BVC kommer du att träffa en sjuksköterska som kommer att prata en stund med dig om hur du mår och vad du gillar att äta, dricka och vad du gillar att göra och leka. Sedan kommer du att göra massa med andra saker. Se på bilden!

Jag heter Mariette och jag kommer också att träffa dig på BVC. Jag kommer att titta på när ni pratar, om du och dina föräldrar tycker att det är ok.
Appendix 4
Avhandlingar i ämnet vårdvetenskap vid forskargruppen ”Barns och familjers hälsa”, vid Institutionen för Hälsovetskaper, Medicinska fakulteten, Lunds universitet.

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