From DEPARTMENT OF CLINICAL SCIENCE, INTERVENTION AND TECHNOLOGY, DIVISION OF PEDIATRICS
Karolinska Institutet, Stockholm, Sweden

EARLY OBESITY: FAMILY-BASED RISK FACTORS AND TREATMENT INTERVENTIONS

Anna Ek

Karolinska Institutet

Stockholm 2016

Cover photo: One of the families in the More and Less study.
Photos in thesis: Early STOPP and More and Less families.
The cover photo and three photos in the thesis were taken by Nicklas Thegerström.
All previously published papers were reproduced with permission from the publisher.
Published by Karolinska Institutet.
Printed by Eprint AB 2016

ISBN 978-91-7676-381-0

Early Obesity: Family-based Risk Factors and Treatment Interventions

THESIS FOR DOCTORAL DEGREE (Ph.D.)

For the degree of Ph.D. at Karolinska Institutet. The thesis is defended in lecture hall C1:87, Karolinska University Hospital Huddinge.

Friday September 23, 2016 at 10 am

By

Anna Ek
BSc, Reg. dietician

Principal Supervisor:
Associate Professor Paulina Nowicka
Karolinska Institutet
Department of Clinical Science, Intervention and Technology
Division of Pediatrics

Co-supervisors:
Professor Claude Marcus
Karolinska Institutet
Department of Clinical Science, Intervention and Technology
Division of Pediatrics

Science Director Patricia Chamberlain
Oregon Social Learning Center

Professor Philip Fisher
University of Oregon
Department of Psychology

Opponent:
Professor Pinki Sahota
Leeds Beckett University
Faculty of Health and Social Sciences

Examination Board:
Professor Finn Rasmussen
Karolinska Institutet
Department of Public health

Professor Christel Larsson
Gothenburg University
Department of Food and Nutrition and Sport Science
Faculty of Education

Associate Professor Silje Steinsbekk
Norwegian University of Science and Technology
Department of Psychology

Till Staffan, Melker och Alice, mina hjältar

ABSTRACT

Background

The high prevalence of preschool obesity is a global concern. In order to support families through obesity interventions, we need a better understanding of underlying family-based risk factors. Specifically, there is a gap in the knowledge related to challenges that families face in everyday life. Thus, valid and reliable instruments to assess child and parental behaviors are required. Further, obesity treatment in early childhood seems to be more effective than treatment of adolescents but the support offered to parents needs to be optimized.

Aims

The overall aim of this thesis was to examine the family's role in early childhood obesity.

Study I: To examine associations between infant growth and known early risk factors.

Study II and III: To validate two questionnaires on child and parental behaviors related to obesity and to examine associations between potential confounders.

Study IV: To describe the conceptual frame and design of a novel parent-only treatment program for early childhood obesity, the More and Less (ML) study.

Study V: To examine the effects of a parent-only program as compared to standard care as a treatment for preschool obesity (primary outcome body mass index standard deviation score; BMI SDS). To assess the acceptance and feasibility of the parent-only program.

Materials

Three samples of parents and preschoolers from Stockholm County were examined:

Study I: 197 one-year-old children (52% girls, mean BMI SDS -0.4) and their parents (mean age 35 years, mean body mass index (BMI) 29, 54% had a university degree and 13% born in a non-Nordic country) participating in the Early Stockholm Obesity Prevention Project (Early STOPP) recruited from child health care centers in Stockholm County.

Study II and III: A school sample of 431 parents of preschoolers recruited via 25 preschools/schools and a clinical sample of 47 parents from the ML study recruited through child health care centers. In this sample, 80% of the children were of normal weight and 20% had overweight or obesity (mean age 5.5 years, mean BMI SDS 0.2). The parents were 39 years old on average with mean BMI of 24; 70% had a university degree and 13% were born in a non-Nordic country.

Study IV-V: 177 children aged 4-6 years with obesity (56% girls, mean age 5.2 years, mean BMI SDS 3.2) and their parents (mean age 38 years, mean BMI 29, 57% of foreign background, 40% had a university degree) were randomized to either parent-group treatment (n=89) or to standard treatment (n=88).

Methods

Study I: Infant BMI SDS at 3, 6 and 12 months and rapid weight gain during the first year of life was compared between children at high and low risk of developing obesity based on parental BMI (n=144 high risk and n=53 low risk) and education level (n=57 high risk and n=139 low risk), adjusting for early life risk factors.

Study II: We translated and validated the Lifestyle Behavior Checklist (LBC), a questionnaire measuring obesity-related child behaviors (Problem scale) and parents' confidence (Confidence scale) in handling these behaviors. Parents' understanding of the translated questions was assessed with cognitive interviews. Confirmatory factor analysis (CFA) was used to assess psychometric properties. We also examined associations between the LBC and the Child Feeding Questionnaire (CFQ), which measures parental feeding practices, and sociodemographic factors.

Study III: We validated the Child Eating Behavior Questionnaire (CEBQ) with CFA. We also examined associations between child eating behaviors and CFQ parental feeding practices with structural equation modelling (SEM), adjusting for sociodemographic factors. Parents' concern for their child being overweight was used as a mediator in the model.

Study IV-V: We compared a parent-only program (10 sessions at 1.5 h/week) based on skills training in evidence-based positive parenting practices to standard treatment focused on lifestyle changes. BMI SDS

(primary outcome) was measured at 3 and 6 months follow-up, adjusting for sociodemographic factors. Acceptance of the parent-only program by parents was assessed by mean scores on evaluation forms and by reviewing interviews with participants. The interviews were evaluated with thematic analysis.

Results

Study I: Child BMI SDS during the first year of life was associated to parental education level but not to parental BMI. The associations could not be explained by previously known risk factors. No associations were found for rapid weight gain.

Study II: A five factor structure of the LBC proved best fit to the data, introducing a new factor, Screen time. The validity of the LBC was proven by: correlations to the CFQ, associations to child BMI SDS and different scorings of parents of normal weight and overweight/obese children. The LBC Confidence scale proved to be unidimensional and was not associated to any child or parental characteristics.

Study III: An eight factor structure of the CEBQ proved best fit to the data. Child's small appetite was associated to higher levels of parental pressuring feeding practices. A large appetite in the child was not directly associated to restrictive feeding practices but indirectly via parental concern for the child being overweight.

Study IV-V: Children in the parent-only group reduced their BMI SDS after 3 (0.21) and 6 months (0.42) compared to an increase of 0.01 at 3 months and 0.02 at 6 months in the standard treatment group ($p < 0.001$). The parent-only group children were four times more likely to reach a clinically significant reduction of 0.5 in BMI SDS. Children of Swedish parents with a university degree succeeded better in treatment. The program was highly accepted by parents.

Conclusions

Parental education level is important for infant weight development as early as the first year of life, independent of parental BMI and other known early risk factors for childhood obesity. To be able to help families in treatment, we need to know what challenges the family faces in everyday life. Thus, valid and reliable instruments to assess child and parental behaviors are required. The LBC and the CEBQ are two such instruments. The associations found between child eating behavior and parental feeding practices suggest an important role for child health care practitioners to support appropriate feeding practices. Further, a parent-only program including skills training in positive parenting practices outperformed standard treatment of preschool obesity regarding child weight status. The program was well accepted by parents. This thesis strengthens the evidence for early initiated obesity interventions and elucidates considerations for reaching families of different socioeconomic backgrounds.

SVENSK SAMMANFATTNING

Bakgrund

Den höga förekomsten av fetma hos förskolebarn är oroväckande. För att på bästa sätt stödja familjer i att komma till rätta med barnets vikt krävs bättre förståelse av bakomliggande faktorer. Vi vet till exempel väldigt lite om vilka utmaningar föräldrarna upplever i vardagen kring barnets beteenden eller i sitt föräldraskap. För att öka förståelsen behövs tillförlitliga och validerade enkäter som mäter dessa beteenden. Fetmabehandling som påbörjas tidigt i barndomen är mer effektiv än behandling i tonåren, men vilket stöd vi ska erbjuda föräldrar i behandlingen behöver utredas ytterligare.

Syfte

Det övergripande syftet med denna avhandling var att undersöka familjens roll kring fetma i förskoleåldern. De specifika syftena var:

Studie I: Att undersöka samband mellan viktutveckling under första levnadsåret och kända tidiga riskfaktorer.

Studie II och III: Att validera två enkäter som mäter barn- och föräldrabeteenden relaterade till fetma samt att undersöka samband mellan sociodemografiska faktorer.

Studie IV: Att i ett metodprotokoll beskriva utformning och metoder av ett nytt program i gruppform för föräldrar med fokus på positivt föräldraskap som behandling av tidig fetma, Mer och Mindre (MoM) studien.

Studie V: Att undersöka effekterna av ett föräldrastödsprogram med fokus på positivt föräldraskap som behandling av fetma i förskoleåldern jämfört med standardbehandling (primärt utfallsmått body mass index standard deviation score (BMI SDS)). Att bedöma genomförbarhet och acceptans av föräldraprogrammet.

Studiepopulationer

Tre olika barn- och föräldrapopulationer boende i Stockholms län har studerats:

Studie I: 197 barn 1 år gamla (52% flickor, medel BMI SDS -0,4) och deras föräldrar (i genomsnitt 35 år, genomsnittligt body mass index (BMI) 29, 54% med en universitetsexamen och 13% födda utanför Norden) som deltar i studien Early Stockholm Obesity Prevention Project (Early STOPP). Familjerna rekryterades genom barnhälsovården i Stockholms län.

Studie II och III: 431 föräldrar till förskolebarn som rekryterats via förskolor och skolor samt 47 föräldrar som deltog i MoM studien och som rekryterades genom barnhälsovården. Barnen var i genomsnitt 5,5 år och hade ett genomsnittligt BMI SDS på 0,2 (80% med normal vikt, 20% med övervikt/fetma). Föräldrarna var i genomsnitt 39 år, genomsnittligt BMI 24, 70% med en universitetsexamen och 13% var födda utanför Norden.

Studie IV-V: 177 barn 4-6 år med fetma (56% flickor, medelålder 5,2 år, genomsnittligt BMI SDS 3,2) och deras föräldrar (medelålder 38 år, genomsnittligt BMI 29, 57% med utländsk bakgrund, 40% med en universitetsexamen) randomiserades antingen till föräldraprogram (n = 89) eller till standardbehandling (n = 88).

Metod

Studie I: Barns BMI SDS vid 3, 6 och 12 månaders ålder samt snabb viktuppgång under det första levnadsåret jämfördes mellan barn med hög och låg risk att utveckla fetma baserat på föräldrarnas BMI (hög risk n = 144, låg risk n = 53) och utbildningsnivå (hög risk n = 57, låg risk n = 139) justerat för tidiga riskfaktorer.

Studie II: Vi översatte och validerade enkäten Lifestyle Behavior Checklist (LBC), en enkät som mäter fetmarelaterade problembeteenden hos barn (Problemskalan) samt vilket självförtroende föräldrarna har i att hantera dessa beteenden (Självförtroendeskalan). För att få en bättre bild över hur föräldrarna upplevde frågorna i enkäten utfördes kognitiva intervjuer. För att bedöma enkätens psykometriska egenskaper användes konfirmatorisk faktoranalys (Confirmatory factor analysis, CFA). Vi undersökte också associationer mellan LBC och enkäten Child Feeding Questionnaire (CFQ) och sociodemografiska faktorer. CFQ mäter hur föräldrar agerar i matsituationer med barnet samt föräldrars attityder kring mat.

Studie III: Vi validerade enkäten Child Eating Behavior Questionnaire (CEBQ) med CFA. Genom strukturell ekvationsmodellering (SEM) undersökte vi samband mellan barns ätbeteenden och hur föräldrar agerar i matsituationer (mätt med CFQ). Föräldrarnas oro för barnets vikt användes som mediator i modellen som också justerades för sociodemografiska faktorer.

Studie IV-V: Vi jämförde ett föräldraprogram (10 sessioner, 1,5 h/vecka) med fokus på positivt föräldraskap och standardbehandling med fokus på livsstilsförändringar avseende BMI SDS mätt vid 3 och 6 månaders uppföljning (primär utfallsvariabel), justerat för sociodemografiska faktorer. Genomförbarhet och acceptans bedömdes utifrån medelvärden på utvärderingsformulär från föräldraprogrammet och genom intervjuer med deltagarna. Intervjuerna utvärderades med tematisk analys.

Resultat

Studie I: Högre viktstatus hos barnen under det första levnadsåret var associerat med lägre utbildningsnivå hos föräldrarna men inte till ett högre BMI hos föräldrarna. Associationerna kunde inte förklaras av tidigare kända riskfaktorer. Inga samband hittades för tidig snabb viktuppgång.

Studie II: Faktoranalysen av LBC identifierade fem faktorer med god intern reliabilitet. Validiteten för LBC bevisades genom korrelationer med CFQ, associationer till viktstatus hos barnen. En skillnad i hur föräldrar till normalviktiga och föräldrar till barn med övervikt/fetma svarade på enkäten stärkte validiteten ytterligare. Självförtroendeskalan visade sig vara endimensionell och för den sågs inga samband med sociodemografiska faktorer.

Studie III: Faktoranalysen av CEBQ identifierade åtta faktorer med god intern reliabilitet. För barn med liten aptit rapporterade föräldrar en högre grad av trugande. Föräldrar rapporterade inte att de var mer restriktiva mot ett barn med stor aptit om de inte var oroliga över barnets vikt.

Studie IV-V: Barn vars föräldrar deltog i föräldraprogrammet minskade sitt BMI SDS mer än barn som fått standardbehandling ($p < 0.001$) både efter 3 (- 0,21 vs 0,01) och 6 månaders uppföljning (- 0,42 vs 0,02). Sannolikheten för att barnen skulle nå en klinisk signifikant minskning i BMI SDS (0,5) var fyra gånger högre i föräldraprogramsgruppen. Barn till föräldrar med svenskt ursprung och med universitetutbildning lyckades bättre i behandlingen. Föräldraprogrammet var väl accepterat av föräldrarna.

Slutsatser

Föräldrars utbildningsnivå har en betydelse för barns viktutveckling redan under första levnadsåret, oberoende av föräldrarnas viktstatus och andra kända tidiga riskfaktorer för fetma. För att bättre kunna ge stöd till familjer i behandlingen av barns fetma behöver vi vidga vår kunskap kring vilka utmaningar familjen möter i vardagen. Följaktligen behövs validerade och tillförlitliga enkäter som mäter fetmarelaterade barn- och föräldrabeteenden. LBC och CEBQ är två sådana enkäter. De samband som finns mellan barns ätbeteenden och föräldraskap tyder på att barnhälso- och sjukvårdspersonal har en viktig roll i att stödja lämpliga föräldrabeteenden. Ett nytt föräldraprogram med fokus på positivt föräldraskap som behandling av fetma i förskoleåldern var mer effektivt än den standardbehandling som idag erbjuds. Föräldraprogrammet var dessutom väl accepterat av föräldrarna. Denna avhandling bekräftar betydelsen av tidigt initierade insatser mot fetma och att vi i dessa interventioner måste ta hänsyn till hur vi bäst når familjer med olika socioekonomisk bakgrund.

LIST OF SCIENTIFIC PAPERS

I. **Infant growth is associated with parental education but not with parental adiposity – Early Stockholm Obesity Prevention Project**
V. Svensson*, A. Ek*, M. Forssén, K. Ekbom, Y. Cao, M. Ebrahim, E. Johansson, H. Nero, M. Hagströmer, M. Ekstedt, P. Nowicka and C. Marcus.
Acta Paed. 2014. 103(4):418-25.

II. **Child behaviors associated with childhood obesity and parents' self-efficacy to handle them: Confirmatory factor analysis of the Lifestyle Behavior Checklist**
A. Ek, K. Sorjonen, J. Nyman, C. Marcus and P. Nowicka.
Int J Behav Nutr Phys Act. 2015. 11;12:36.

III. **Associations between parental concerns about preschoolers' weight and eating and parental feeding practices: Results from analyses of the Child Eating Behavior Questionnaire, the Child Feeding Questionnaire, and the Lifestyle Behavior Checklist.**
A. Ek, K. Sorjonen, K. Eli, L Lindberg, J. Nyman, C. Marcus and P. Nowicka.
PLoS One. 2016. 11(1).

IV. **The More and Less Study: a randomized controlled trial testing different approaches to treat obesity in preschoolers**
A. Ek, K. Lewis Chamberlain, K. Sorjonen, J. Nyman, L. Lindberg, M. Etminan Malek, S. Hörman, S. Ito, J. Ejderhamn, P.A. Fisher, C. Marcus, P. Chamberlain and P. Nowicka.
BMC Public Health. 2015. 1;15:735

V. **General parenting in treatment of preschool obesity: The first results from the randomized controlled More and Less study**
A. Ek, K. Lewis Chamberlain, K. Sorjonen, J. Nyman, L. Lindberg, M. Etminan Malek, S. Hörman, S. Ito, J. Ejderhamn, P.A. Fisher,
P. Chamberlain, C. Marcus and P. Nowicka
Manuscript

* Shared first authorship

CONTENTS

LIST OF ABBREVIATIONS

BMI	Body mass index
BMI SDS	Body mass index standard deviation score
CEBQ	Child Eating Behavior Questionnaire
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CFQ	Child Feeding Questionnaire
CN	Concern
CONF	Confidence scale
DD	Desire to drink
Early STOPP	Early Stockholm Obesity Prevention Project
EF	Enjoyment of food
EFA	Exploratory factor analysis
EMO	Emotional correlates for being overweight
EOE	Emotional overeating
EUE	Emotional undereating
FF	Food fussiness
FIML	Full information maximum likelihood
FR	Food responsiveness
KEEP	Keeping foster and kin parents supported and trained
LBC	Lifestyle Behavior Checklist
MB	Misbehavior in relation to food
MI	Motivational interviewing
ML	More and Less
OR	Odds ratio
OE	Overeating
OSLC	Oregon Social Learning Center
p	Significance level
PA	Physical activity
r	Correlation coefficient
RCT	Randomized controlled trial

REML	Restricted maximum likelihood
RMSEA	Root mean square error of approximation
RR	Risk ratio
SD	Standard deviation
SE	Slowness in eating
SEM	Structural equation model
SES	Socio-economic status
SR	Satiety responsiveness
SRMR	Standardized root mean square residual
ST	Screen time
TLI	Tucker-Lewis index
WHO	World Health Organization

1 INTRODUCTION

In this thesis I address the family's role in early childhood obesity and emphasize the importance of recognizing obesity and intervening early, when the child is preschool aged. To be able to help families in treatment, we need to know what challenges the family faces in everyday life. Thus, valid and reliable instruments to assess child and parental behaviors are required. In this thesis two such instruments are examined. Further, when obesity is identified, health care providers need to have effective interventions to offer the families. Results from one such intervention are presented in this thesis.

1.1.1 Definition of obesity in children

Overweight and obesity are defined as an excessive or abnormal amount of adipose tissue that presents a risk to health [1]. Body mass index (BMI = kg/m^2) is a crude measure widely used to define overweight and obesity. BMI has been criticized for not being sensitive enough to detect differences in body composition (i.e., fat mass and fat free mass) [2], nevertheless, it is a simple and practical method to use. In children and adolescents, however, we need to take into account growth development at different ages and can therefore not use the same cut-offs for BMI as for adults, BMI $\geq$ 25 for overweight and BMI $\geq$ 30 for obesity. Reference values created by the International Obesity Task Force based on child weight, height, BMI, age and gender are instead frequently used [3, 4]. In addition, to be able to compare weight status between groups of children of different ages and different genders, body mass standard deviation score (BMI SDS) is commonly chosen in the literature using a representable reference population [5].

1.1.2 Prevalence

Never before has the prevalence of childhood obesity been as high worldwide as today [6]. Although a leveling-off effect has been reported in parts of the Westernized world, overweight and obesity is now becoming more problematic in the less developed world [7, 8]. Additionally, the sociodemographic gradient of obesity is becoming clearer [9]: children in more socioeconomically challenged families regarding family income, education and immigrant background are at increased risk of obesity [7, 10-14]. In Sweden, the prevalence of overweight and obesity is also higher for children from rural areas [10]. In Stockholm, 9.4% of 4 year olds were identified as overweight and 1.8% as obese [15]. However, even at this young age there is already a large variation in prevalence depending on the area of Stockholm where the children reside, with a prevalence of overweight and obesity of 7.1% in the affluent central city areas and as high as 18.6 % in the less affluent suburban areas [15]. More girls than boys were overweight and obese at age 4 (11.2% overweight and 2.1% obese girls and 7.8% overweight and 1.6% obese boys) [15]. However, in 8 and 12 year olds living in Stockholm County, the gender differences were reversed; 10.5% overweight and obesity in 8 year old girls compared to 12.1% in boys and 9.3% in 12 year old girls compared to 12.7% in boys [16]. These figures were also somewhat lower than those for the Swedish representative sample with 12.8% for girls and 16.0% for boys [16]. In Western Sweden [14], the prevalence

of overweight and obesity in 7- to 9-year-old children was 18.8% and 3.1%, respectively, with a higher prevalence in girls compared to boys. For overweight, the prevalence was 21.3% compared to 16.4% and for obesity 3.3% compared to 2.9% [14].

1.1.3 Consequences

Children with obesity are significantly less likely to live a healthy life [17]. Robust evidence shows that obesity is a persistent condition that has severe long-term physical [18] and psychological health consequences [19]. The high prevalence of obesity with related co-morbidities not only leads to individual suffering but also to high societal costs [20]. The higher health care costs for obese individuals appear as early as the preschool years [21]. The physical consequences of obesity in early childhood include sleep apnea, asthma, airway obstructions, fractures, sprains and musculoskeletal pains [21]. The associations between childhood obesity and later metabolic health and premature death have been demonstrated [18, 22]. In a UK study, composite metabolic score, taking several metabolic markers into account (insulin resistance, mean blood pressure, triglyceride level and total cholesterol/high density lipoprotein cholesterol ratio), was found to be associated to weight status as early as 5 years of age, a link that becomes even stronger at 9 years of age [23]. Further, in a large European study including 2- to 9-year-old children with higher levels of high sensitivity C-reactive protein (a marker for inflammation) at baseline had an increased risk of overweight and obesity 2 years later [24]. Entering puberty is another risk factor; metabolic risk factors emerged in previously metabolically healthy obese children in a German cohort [25]. In summary, metabolic health is a concern as early as the preschool age in children with obesity and worsens during the adolescent years even in previously metabolically healthy children with obesity.

Psychosocial health has been reported to be lower in obese children compared to normal weight peers, especially in those children seeking treatment [26, 27]. In fact, children 5- to 19-years-old with obesity ranked their quality of life as lower than those diagnosed with cancer [28]. Contributing to obese children's low quality of life is the stigmatization of obesity; it is extensive and needs to be counteracted [29]. Stigmatization starts early: 4- to 11-year-old children expressed negative attitudes towards obesity; this was especially evident in older children with higher socioeconomic status (SES) [30]. In adulthood, stigmatization leads to unjust treatment in health care, enrollment in university and employment [31, 32]. The short- and long-term psychosocial health consequences of obesity leading to severe individual suffering across the lifespan motivate early-initiated interventions [29].

1.2 FAMILY-BASED RISK FACTORS OF CHILDHOOD OBESITY

The cause of childhood obesity is multifaceted and not always as straightforward to understand. Thus, we need not only consider a person's food intake and physical activity levels leading to positive energy balance resulting in obesity, but we also need to reflect on biological, behavioral, socioeconomic and societal aspects of the patient's situation [33]. Obesity in childhood poses a risk factor for later obesity in itself; children and adolescents

with obesity have a 5 times greater risk for carrying obesity to adulthood, compared to normal weight peers [34]. Awareness of risk factors helps us offer more appropriate support to families in prevention and in treatment [35]. Thus, if the factors targeted for preventing or treating obesity are not causal for obesity for a particular patient, the treatment or prevention will not be successful [33]. Below are some of the strongest risk factors for childhood obesity.

1.2.1 Parental overweight and obesity

The strongest risk factor for obesity in childhood and in adulthood is parental weight status, likely caused by genetic inheritability, social and environmental factors [36, 37]. In the population-based Generation R study from the Netherlands, 4 year olds with two obese parents were more than 6 times more likely to be overweight compared to children with normal weight parents [38]. In Sweden, 7- to 9-year-old children were more than 14 times more likely to be obese compared to children with two normal weight parents [10]. The genetic impact on weight status has been proven in several twin studies with increasing importance from infancy to adolescence where it could explain as much as 80-90% of the variance in weight status [39-41]. However, the identified obesity genes can only explain 2.7% of the variance in BMI [42]. Thus, we need to continue our search for modifiable factors in the environment to slow down the obesity epidemic and find factors that are more harmful to those with a stronger predisposition to obesity [41].

1.2.2 Parental socioeconomic status

Parental education level is most often used as a proxy for SES [43]. Other commonly used variables include income and neighborhood, however; parental education level has been characterized as more stable and accurate and thus a more valid variable [44]. The mechanisms of SES on child weight development are not clear and differ between countries and within countries depending on factors such as age, gender, ethnicity/immigrant status, inequality rates and neighborhood (higher rates of obesity in rural areas) [7, 8, 12, 13, 45]. The strong negative or inverse associations between parental education level and child obesity are clear in Western society [44]. Although, the same socioeconomic gradient is becoming more evident in less affluent countries where previously, a positive relationship was expected [46]. However, this positive relationship is still found in Europe (Bulgaria and Lithuania) including countries characterized by different economic growth [47]. The associations between a higher child weight status and a lower parental education level have been detected during infancy independent of parental weight status [44, 48]. However, the relationships seem to strengthen between the ages 3 to 4 years when the social gradient of obesity widens [9, 49]. The mechanisms suggested behind education level and child weight status (e.g., knowledge, beliefs and attitudes and income) are related to external influences (e.g., media, cultural beliefs) and access to resources (e.g., healthy foods, leisure time activities) [9, 13, 50, 51]. These mechanisms need to be considered in obesity interventions in order to close the socioeconomic gap of obesity.

1.2.3 Sociodemographic aspects

Children of parents of foreign origin/immigrant background have repeatedly been identified as having a higher risk for overweight and obesity [10, 12, 45, 52, 53]. In a large Swedish population-based study, the prevalence of overweight and obesity was significantly higher in 4- to 5-year-old children of North African, South American and Turkish born mothers (28, 32, and 31%, respectively) compared to children of Swedish born mothers (19%) [12]. The causes of these associations are not clear, however, ethnicity has been associated with a higher risk for rapid weight gain in infancy, controlling infant feeding practices, shorter sleep duration, higher intake of energy dense foods and sugar sweetened beverages and higher levels of sedentary behaviors independently of parental SES status and parental obesity [53]. Cultural attitudes towards body weight ideals (e.g., a higher weight in the child is seen as healthy) may also in part explain a higher weight in children with an immigrant background [45, 54]. Another factor to consider is the psychosocial health of immigrated parents and the stress such a situation may induce. Maternal stress has been associated with obesity-related parenting practices [55-58]. Additionally, sense of coherence, a measure of an individual's ability to cope with stress was reported to be lower in mothers with an immigrant background [59]. The increased number of immigrants in Sweden and globally calls for extra resources to support interventions that guard against child health inequalities [52].

1.2.4 Early risk factors

1.2.4.1 Maternal smoking in pregnancy

Maternal smoking during pregnancy has been associated with an increased risk for later obesity in childhood [60-62]. The risk is independent from other socioeconomic factors often related to smoking such as education level and maternal age [61, 63] and of lower birth weight and rapid weight gain [60]. Further, the association between maternal smoking and later obesity seems to be higher than that of paternal smoking [63]. The mechanisms for the increased risk are therefore suggested to be related to the effects of smoking in the intrauterine environment [63]. The negative effects on the offspring's health are serious and support preventive interventions against smoking for women of the reproductive age.

1.2.4.2 Gestational weight gain

A high gestational weight gain is related to a higher risk of offspring overweight and obesity [62, 64, 65]. The Institute of Medicine developed guidelines for optimal gestational weight gain. Offspring of normal weight women exceeding these guidelines had a 50% higher fat mass compared to mothers with a lower weight gain [64]. Examining the impact of later weight status, in a large study of over 10,000 children excessive gestational weight gain was associated to a 50% increased risk of overweight when the children were 7 years of age [66].

1.2.4.3 Birth weight and rapid growth

High birth weight (> 4000 g) has been associated with obesity in later childhood [67, 68]. The associations of low birth weight or small for gestational age babies and later obesity are less

clear [67]. However, low birth weight is associated with a higher proportion of central fat mass and this abnormal body composition has been tracked into adulthood and was especially profound if a low birth weight was combined with rapid weight gain [69]. Rapid weight gain is defined as an increase above 0.67 during the first 6 months and has been associated with obesity in later childhood [62, 69].

1.2.4.4 Short exclusive breastfeeding and early introduction of solid foods

The relationship between breastfeeding and obesity has been extensively examined [62]. However, the evidence is mixed with studies supporting a protective effect and studies failing to find a relationship [62]. Thus, the possible protective mechanisms need to be further clarified.

Another early feeding factor of interest for later weight development is the timing of introduction of solid foods. Introduction of solid foods before 4 months has been associated to later risk of obesity, especially in formula fed infants [70, 71]. However, the inconclusive results of the impact of the early introduction of solid food on later obesity need to be further clarified [62].

1.2.5 Modifiable behavioral risk factors of obesity

1.2.5.1 Food habits and physical activity

Food habits and food preferences are often learned and established in childhood [72-75]. Supporting healthy food habits has an obvious role as one of the cornerstones in the prevention and treatment of obesity [76]. Together with physical activity, food habits are often the only tool for health professionals to work with. Specific food habits considered valuable for optimal development in children are: varied food intake for adequate nutritious value, regular meal patterns, portion sizes, vegetable and fruit intake, whole grain foods, low intake of saturated fat, low intake of energy dense food and drinks (e.g., fast food and sugar sweetened drinks) [77-79]. Among these, sugar-sweetened drinks have the strongest association to overweight and obesity [80-82]. However, measuring food habits has many limitations often related to the method used and self-reporting bias [83]. To advance research in the field, characterizing the quality of whole diets has been suggested to be more appropriate [74, 84]. Although when analyzing whole diets of preschoolers no clear relationship for adiposity was detected [74]. However, examining long-term effects of diets from early childhood, dietary patterns that were energy-dense, high-fat and low in fiber was associated to later obesity [84].

Physical activity has many benefits on physical health and is therefore encouraged through everyday activities, sports and especially by a restriction of sedentary activities (screen time) [85]. However, the dose-response relationship between physical activity and adiposity in early childhood is not clear [86, 87]. Longitudinal studies have found increased sedentary behavior with age [87, 88]. Increased sedentary behavior is a concern; high levels of screen time have been associated to higher weight status in children and also related to higher snack intake and sugar-sweetened drinks [89-91].

1.2.5.2 Eating behavior

For parents, children's eating behaviors are often more challenging to handle than knowing what type of food to offer [92]. Eating behaviors associated with weight status and most often described in the literature are based on different appetitive traits [93]. The traits are commonly represented in two dimensions describing how responsive the child is to food: food approach and food avoidance [94]. Food approach includes traits describing a child with a large appetite and with low satiety response (e.g., the child constantly expresses hunger, rarely says no to food and eats fast) [94]. Food avoidance, on the other hand, describes a child less interested in food and with a high satiety response (e.g., picky eater who rarely finishes the plate and eat at a slow pace [94]. Parents of children with obesity report higher levels of food approach whilst food avoidance is more often associated to a lower weight status [93]. Although the way the child eats (or not eats) may be highly frustrating for parents, eating behaviors seem possible to modify as an intervention based on positive feeding practices in preschoolers showed promising results [95]. Compared to the control group, the intervention resulted in higher levels of satiety responsiveness and lower food responsiveness; the results were maintained after 2 years [95]. Addressing eating behaviors in treatment may, thus, offer parents more tools to work with to come to terms with their child's obesity [96].

1.2.5.3 Parental feeding practices

Parents influence child eating through foods offered in the home environment [72], role modeling [97] and through feeding practices [98]. Parental feeding practices are defined as to how parents respond to the child in feeding situations [99]. In the literature, feeding practices related to weight status are most often examined regarding the level of control in feeding situations [100]. Controlling feeding practices include both restriction of how much and what type of food the child eats and to what extent parents pressure their child to eat [101]. Associations between food approach and restrictive feeding practices and food avoidance and pressure to eat have been reported independently of child weight status [102]. Not surprisingly, associations between a higher weight status in children and restrictive feeding practices and lower weight status and pressure to eat have been reported in both cross sectional and

longitudinal studies [103-108]. However, the causal relationships are not clear. Longitudinal studies suggest that feeding practices are a natural response to the child's eating behavior and weight status [106, 107, 109]. Interestingly, parental concern for their preschooler's weight influenced feeding practices more than the child's actual weight [110]. To guide parents in feeding practices, techniques that facilitate healthy eating may be especially helpful for parents of an obese child [111].

1.2.5.4 Evidence-based positive parenting practices

The key role of parents in shaping a healthy lifestyle for children makes general parenting a clear component for inclusion in childhood obesity treatment. General parenting has been defined as attitudes and beliefs that create an emotional climate and determines behavioral communication between the parent and the child [112, 113]. However, in this thesis, general and positive parenting practices are used to describe the key evidence-based parenting practices: *encouragement*, *monitoring*, *involvement*, *limit setting* and *problem solving strategies* [114]. These positive parenting practices are the cornerstones of many parenting programs. One such program is KEEP (Keeping foster and kin parents supported and trained), an evidence-based parent support and skill enhancement education program that has been tested in multiple settings and was developed by Patricia Chamberlain from the Oregon Social Learning Center (OSLC) in the USA [115, 116]. In this thesis the adaptation of KEEP to a Swedish population of parents of preschoolers with obesity will be presented as well as the first results from a randomized controlled trial (RCT).

Positive parenting practices contribute to better cooperation in the family and help parents to achieve behavior changes in their children supporting a healthy development [117-119]. The inclusion of support in positive parenting practices in obesity treatments is however largely understudied; there are few predominantly encouraging results [120-123]. In Australia, a positive parenting program targeting for parents of school-aged children resulted in improved child weight status and increased parental confidence in managing child obesity-related behaviors and inconsistent or forceful parenting practices were used less frequently [122]. However, when the same program was evaluated in the Netherlands no effects after 12 months were seen [124]. A possible explanation was the absence of follow-up visits to ensure the establishment of the newly learned practices [124]. The scarcity of studies targeting and examining the role of parenting practices in the treatment of preschool obesity thus needs to be further investigated.

1.3 PREVENTION OF CHILDHOOD OBESITY

There is a consensus that preventive interventions are needed to counteract the obesity epidemic. However, the successes from large extensive interventions are limited [33, 125-127]. In Europe, the community-oriented obesity prevention study IDEFICS (8 countries, 16,000 children 2- to 10-years-old) failed to find clinically relevant intervention effects regarding child adiposity [126]. Similarly, TOYBOX (6 countries, 4,964 preschoolers) found no relevant effect on improved beverage intake [127]. In Sweden, the Primrose study delivered through

child healthcare centers (1,041 children) also failed to show any intervention effect on child weight development [125]. The idea behind preventive interventions is to target large samples of the general population and offer the same tools to everyone. However, for those at higher risk of becoming obese, differentiation in the interventions is critical [125]. Further, to reach population-representative samples, preventive strategies for children are often offered through schools and preschools [128]. At the same time, such design limits the participation of parents and thereby limits the intervention effect [128]. On the other hand, interventions offered through primary health care, and thus only target parents, are also presenting limited results [125, 129]. The lack of intervention effect may however be due to the fact that the intervention effect is time lagged thus longer follow-up is possibly required to detect larger and relevant effects of interventions, especially in younger children [125, 128, 130]. Thus, it is too early to state that prevention of obesity in children doesn't work. The multifaceted nature of obesity also requires a better consideration of several levels within the society (e.g., home, school, after school activities and the overall community level) [130]. Further, the implementation of any preventive actions needs to be closely followed to avoid flaws in one level affecting the results of the whole intervention [33]. While seldom reported, no harm has been reported for preventive interventions, according to a recent comprehensive review of the field [128].

1.4 EARLY TREATMENT OF CHILDHOOD OBESITY

1.4.1 When should treatment start?

While obesity treatments in adolescents and adults have shown discouraging outcomes, a growing body of evidence points toward the importance and effectiveness of early initiated obesity treatment for long-term treatment results [131, 132]. At what age treatment should start remains an ongoing discussion. Some suggest waiting until early school age as evidence for association between current weight status and adolescence and adulthood is stronger [34]. However, the preschool age seems more appropriate considering the greater influence of parents [133, 134], and the possibility for preventing the establishment of unhealthy habits [73]. Although the preschool age is recognized as a good time to start treatment, there is a scarcity of controlled evaluated treatments [135, 136]. Treatment interventions targeting this young age group need to be further investigated, especially regarding what treatment to offer.

1.4.2 Key mechanisms for early treatment

1.4.2.1 Multidisciplinary treatments

It is now well established that multidisciplinary treatments offering support for both healthy food habits and physical activity with low levels of sedentary behaviors are needed [76, 136]. However, the advices around lifestyle changes need to be supported by behavior management components [76, 135]. Behavioral components included in effective treatment programs are support for parental feeding practices, problem solving and goal setting strategies among others [137-139].

1.4.2.2 Intensive treatments

How intensive (total number of sessions and frequency) an optimal treatment should be is an ongoing discussion. Multidisciplinary treatments of high intensity (e.g., 12 weekly sessions followed by monthly follow-up visits) [137-141] have proven to be more effective in reducing child weight status compared to those of low intensity (4 to 8 visits per year) [142, 143]. Likewise, a medium intensity intervention also demonstrated a significant difference within and between groups in weight status compared to standard treatment [144]. Low intensity treatments (that are often offered in outpatient pediatric clinics as standard treatment) seem to be much less, if at all, effective [135]. On the other hand, a counter argument is that intensive treatments are hard to set up within the health care system. Clearly, the feasibility and cost effectiveness of such treatments need to be further investigated.

1.4.2.3 Parent-only program

Among early obesity treatments, parent-only programs have been showing promising results [28, 121, 145-147]. However, it remains unclear whether a parent-only approach is equally or more effective than treatments involving the child, especially for older children, given the increasing peer influence during childhood [148]. The potential advantage of parent-only treatment is the possible cost-effectiveness and ease of dissemination [147, 149, 150]. A further aspect is the possibility for parents to speak freely about their child's weight problems and concerns they may have. One such concern is how children's self-esteem is affected by having obesity [151]

1.5 IMPORTANCE OF USING VALID AND RELIABLE INSTRUMENTS

Research on child and parental behaviors related to obesity is held back by the limitations of existing instruments [152, 153]. To be able to trust results researchers need valid and reliable instruments [153]. The process of developing new instruments should follow the latest psychometric procedures [153-155]. This process is time-consuming and should include qualitative work such as discussions with experts for input on relevant questions and interviews with a sample representing the population under study. Additionally, instruments need to be tested in a large enough sample so that consistencies and inconsistencies of the instrument can be evaluated and reported [153]. Existing instruments will have to be tested again in new populations since child age, culture and parental education level are known to effect the appropriateness of different instruments [156]. In this thesis two instruments have been validated. The instruments will later be used to advance research regarding which behaviors parents of obese children find problematic and their perception of how they manage these behaviors.

2 AIMS AND HYPOTHESES

The overall aim of this thesis was to examine the family's role in early childhood obesity focusing on parental characteristics and practices, and to compare two treatment interventions offered to preschoolers with obesity.

The specific aims were:

1. To compare infant growth during the first year of life (BMI SDS at 3, 6 and 12 months and rapid growth > 0.67 SD in weight between 0-6 month) between children at high and low risk of developing obesity based on parental BMI and education level. Further, to examine which early-life factor (gender, birth weight, gestational weight gain, short exclusive breastfeeding and maternal smoking) may influence the effect of parental BMI and education level on infant growth. (Study I)

2. To examine the psychometric properties of the Lifestyle Behavior Checklist (LBC) on a Swedish population of parents of preschoolers and to examine associations between the LBC and socio-demographic factors (child and parental age, gender and weight status, parental education level and parental country of origin). (Study II)

3. To establish the psychometric properties of the Swedish version of the Child Eating Behavior Questionnaire (CEBQ) in preschoolers. Secondly, to present a model of associations between parental perceptions of child eating behaviors among preschoolers and parental feeding practices, measured with the Child Feeding Questionnaire (CFQ), adjusting for potentially important predictors (child and parental age, gender and weight status, parental Nordic background, education level and confidence). (Study III)

4. To present a detailed study protocol of the longitudinal RCT, the More and Less study (ML) aiming to compare the effectiveness of two obesity treatment approaches offered in three conditions: 1) standard treatment, and 2) a parent-only treatment program delivered in groups with booster sessions and 3) same as 2) without booster sessions (BMI SDS primary outcome). (Study IV)

   The study protocol is included in this thesis to give a thorough background to Study V.

5. To evaluate treatment effectiveness of the ML parent-only program measured by BMI SDS (primary outcome variable) after 3 and 6 months compared to standard treatment for preschoolers (4-6 year olds) with obesity adjusting for sociodemographic factors (child age, gender, family structure, parental education level, income and foreign background). Second, to examine the feasibility and acceptance of the parent program using evaluation forms and semi-structured interviews with parents. (Study V)

Hypotheses were:

1. Simultaneous exposure to high parental BMI and low education level would increase the risk of a higher child weight status and rapid weight gain during the first year of life. (Study I)

2. LBC factor structure would differ in the younger sample of children compared to previous research that was mostly performed in older children. Additionally, perceived child problematic behavior would be associated with lower parental confidence. We also hypothesized that obesity-related behaviors such as overeating and physical inactivity would be associated with parental concern for child weight and to feeding practices. Further, we hypothesized that child weight status would be associated with all factors on the Problem scale. We assumed no or weak associations between the CFQ factor, perceived parental weight, and the LBC factors. Finally, we expected to find differences between the reports of parents of normal weight children and parents of overweight and obese children. (Study II)

3. Parents' feeding practices are affected by their perceptions of child eating behaviors and that parents' concern for child weight would mediate this relationship. Further, we hypothesized that child weight status and parental education level would be associated with child eating behaviors and parents' feeding practices. (Study III)

4. The parent-only group program will be effective in improving both weight status (BMI SDS as primary outcome) and secondary outcomes such as child BMI, waist circumference, metabolic health, food and physical activity patterns, obesity-related child behaviors, parental limit setting and feeding practices and lifestyle-specific self-efficacy, family functioning and child and parental psychosocial health. (Study IV)

5. The parent-only program would be more effective in reducing child weight status compared to standard treatment. However, we further hypothesized that for both treatment groups there would be an association between treatment attendance and treatment effect. Further, the parent-only program would be well accepted by parents. (Study V)

3 METHODS

3.1 STUDY DESIGN AND POPULATIONS

The design and the populations of each study are presented in Table 1. Below is a short description of the three main projects: the Early Stockholm Obesity Prevention Project (Early STOPP), the validation study and ML.

3.2 MATERIAL

3.2.1 Study I – Early Stockholm Obesity Prevention Project (Early STOPP)

Early STOPP is an ongoing five year longitudinal preventive intervention. The primary aim of Early STOPP is to prevent obesity in children with a higher risk. The risk is based on parental weight status (BMI). Families with infants were recruited from child health care centers in Stockholm County between 2009 and 2013. One-year-old children with no chronic health problems that could influence the child's physical and psychological development and with at least one obese parent (BMI $\geq$ 30) or two overweight parents (BMI $\geq$ 25) [1] were eligible for participation in the study. Another inclusion criterion was parents' ability to communicate in Swedish, in speech and in writing. Eligible families were randomized to intervention or control conditions through cluster randomization of child health care centers. A non-randomized reference group with parents within the normal range for weight status was also recruited to the study. All families are being followed for five years with yearly check-ups. The families in the intervention condition have additional visits. They receive 2 to 4 home visits per year by a personal coach trained in motivational interviewing (MI). The visits focus on healthy habits for children regarding food, physical activity and sleep. Study recruitment has concluded. In total, 238 families have been to baseline measurements (66 intervention, 115 control and 57 reference group families).

In Study I, the intervention and control conditions represent the high-risk group for obesity based on parental BMI (n=144) while the reference group represents the low-risk group (n=53). Additionally, to explore the associations between SES and child weight status during the first year of life, risk groups were based on parental education level (high/low) created as a proxy for SES (high risk (n=57) and low risk (n=139).

Table 1. Design and study population of the studies.

Study	Aim	Design	Population	Recruitment
I	To explore associations between parental weight status and education level and child growth development (BMI SDS and rapid weight gain) during the first year of life.	Longitudinal Observational Retrospective	197 one-year old children and their parents participating in Early STOPP; 144 with high risk of obesity and 53 with low risk of obesity based on parental weight status.	Through child health care centers in Stockholm County.
II	To validate the Lifestyle Behavior Checklist in a Swedish preschool population.	Cross-sectional	478 preschoolers and their parents. Including a clinical sample of 47 families.	Through 20 preschools and 5 schools in Stockholm County. Through child health care, pediatric clinics and school health offices.
III	To validate the Child Eating Behavior Questionnaire in a Swedish preschool population. To present a model of associations between children's eating behaviors and parental feeding practices.	Cross-sectional	478 preschoolers and their parents. Including a clinical sample of 47 families.	Through 20 preschools and 5 schools in Stockholm County. Through child health care centers, outpatient pediatric clinics and school health offices in Stockholm County.
IV	To describe the longitudinal RCT, the More and Less study (ML)	Study protocol	177 children 4 to 6 years old with obesity and their parents.	Through child health care centers, outpatient pediatric clinics and school health offices in Stockholm County.
V	To evaluate treatment effectiveness of the ML parent-only program after 3 and 6 months compared to standard treatment (BMI SDS as the primary outcome) and to examine the feasibility and acceptance of the program.	Longitudinal Prospective Randomized controlled trial (RCT)	177 4 to 6-year-old children with obesity and their parents participating in ML randomized to parent-only group treatment (n=89) and standard treatment (n=88).	Through child health care centers, pediatric clinics and school health offices in Stockholm County.

3.2.2 Study II and III – Two validation studies

Study II and III were designed to test the usefulness (the psychometric properties such as validity and reliability) of the LBC and the CEBQ, two questionnaires that will be used in the evaluation of the ML study described below. In 2013, schools and preschools from different areas of Stockholm County were invited to participate in the validation study. After agreeing to participate, questionnaires were distributed to parents via the schools and preschools. The same population was used in the two validation studies. The population consisted of two samples of parents. One sample was recruited through the preschools and schools (n = 431); the other sample were parents participating in the ML study with their child (n = 47). Parents were asked to fill out a battery of questionnaires including the LBC, the CEBQ and the CFQ. In addition parents received a questionnaire with child and parental sociodemographic data.

3.2.3 Study IV and V – the More and Less study (ML)

ML is an ongoing longitudinal RCT comparing two different treatments of childhood obesity in preschoolers delivered in three conditions for 12 months. In summary, 177 children (4- to 6-years old) were recruited through child health care centers, outpatient pediatric clinics and school health offices in Stockholm County and through self-referrals by parents. The children were randomized to either 1) a 10 week (1.5 h/week) parent-only group treatment focusing on evidence-based parenting practices and lifestyle changes with additional booster sessions or 2) the same as 1) without booster sessions or 3) to standard treatment in a pediatric clinic focusing on lifestyle changes. The outcome measures are collected at baseline and after 3, 6 and 12 months. The primary outcome is child BMI SDS and secondary outcomes are child BMI, waist circumference, metabolic health, eating behavior, food intake and sedentary behavior, parenting feeding and limit setting practices and confidence in handling child obesity related behaviors and child and parental psychosocial health. Sociodemographic variables such as reported parental weight and height, education level, income, occupation status, housing and family structure (marital status, number of siblings) are also collected.

In Study V, the first results of ML are presented comparing the parent-only treatment and standard treatment after 3 and 6 months follow-up (primary outcome BMI SDS). The feasibility and acceptance of the parent-only program, analyzed through quantitative and qualitative evaluations, will also be presented.

3.2.4 Sample sizes

3.2.4.1 Study I

The population size for Study I was determined through power calculations for Early STOPP including 200 families, (intervention = 100 and control = 100), with 80% power at the 5% significance level. We considered a 15-20% dropout rate. The power calculation was based on detecting a 50% lower prevalence of child overweight and obesity in the intervention group: 20% in the intervention group compared to 40% in the control group when the

children were 6 years of age. The reference group (low-risk group for obesity) was planned to include 50 families [157].

3.2.4.2 Study II and III

The sample sizes were based on an estimated response rate of 50%. An adequate amount of data for the use of the chosen statistical methods were also considered (i.e., for exploratory factor analysis (EFA) n > 5 times number of items and for confirmatory factor analysis (CFA) n > 200) [158].

3.2.4.3 Study IV and V

The sample size for the ML study was determined to include 75 children in each group (i.e., the standard treatment group and the parent-only treatment (including both conditions)). The power calculations were based on the assumption that with 85% power to be able to detect a 0.3 difference in BMI SDS between the groups at the significance level of 5% considering a drop-out level of 21% [114].

3.2.5 Inclusion and exclusion criteria

3.2.5.1 Study I

The inclusion criteria for Early STOPP were:

- families with children younger than one year
- at least one parent was obese (BMI ≥ 30), both overweight (BMI ≥ 25) or both parents were normal weight (BMI ≤ 25) (reference group)
- at least one parent was able to understand Swedish in spoken and written language.

The exclusion criteria were:

- chronic health problems that could influence growth, physical activity and/or eating habits of the child.
- For twin pairs the first twin was included. [157].
- For Study I additional exclusion criteria were children born before week 37.

3.2.5.2 Study II and III

For both validation studies inclusion criteria were:

- parents of preschoolers living in Stockholm County
- ability to understand Swedish was assumed for returned questionnaires.

The exclusion criteria were:

- chronic health problems likely to influence child growth, physical activity, eating behavior and parenting practices.
- being underweight (iso BMI 17) [4] leading to exclusion of 18 children as the data was not considered as relevant to the purpose of the studies.

3.2.5.3 Study V

The inclusion criteria for the ML study were:

- children between 4 and 6 years (treatment start before 7 years of age)
- obesity according to international cut-offs for children [3]
- no chronic disease or developmental problem likely to influence child weight and height
- parental ability to understand and communicate in Swedish to be able to fill out questionnaires and participate in treatment held in Swedish .

For Study V families with data collected at baseline and at 3 and 6 months follow-up were included.

3.3 DATA COLLECTION AND DEFINITION OF VARIABLES

3.3.1 Study I

3.3.1.1 Data collection

Data used in Study I was collected at the Early STOPP baseline visit. Families were asked to fill out one questionnaire for each parent and one for the child. The questionnaires contained sociodemographic data and early life factors associated to obesity (see description below). Child and parental height and weight were measured by well-trained research staff using calibrated instruments. All measures were repeated three times and mean values were derived. The child was measured without clothes using a baby scale. Child height was measured horizontally and parents were measured using a fixed stadiometer. Parents' waist was measured in between the lower rib and the iliac crest using a non-extensible tape. For mothers who were pregnant at baseline we used the weight provided when the family had been included to the study (n = 9).

3.3.1.2 Definition of variables

Outcome variables were child growth defined as BMI SDS at 3, 6 and 12 months and rapid weight gain before 6 months of age. Child growth chart from birth was collected and BMI was then calculated for both children and parents. BMI SDS at 3 (± 2 weeks), 6 (± 4 weeks) and 12 (± 8 weeks) months (outcome measures) was derived from Swedish age and gender specific reference values [5]. Rapid weight gain between birth and 6 months was defined as a weight increase of 0.67 SD [159], where weight SD was calculated based on Swedish growth reference data [160].

Exposure variables were created for obesity risk based on: 1) parental BMI and 2) parental education level. Based on BMI, parents were classified as normal weight (BMI $\geq$ 18.5 $\leq$ 25), overweight (BMI $\geq$ 25 $\leq$ 30) or obese (BMI $\geq$ 30) according to the World Health Organization's (WHO) cut-off criteria [1]. Risk group based on parental BMI included families with at least one obese or two overweight parents and as low risk if both parents were normal weight. Risk group based on parental education level was based on a

dichotomized variable where both parents' education level was combined into low or high level of education. High level of education was defined as families with at least one parent with more than 12 years of school and low level of education as both parents with 12 years of school or less.

Variables collected at baseline and adjusted for were child gender and gestational age and previously identified risk factors for childhood obesity: birth weight, introduction of solid foods, antibiotics during the first year, maternal age, maternal gestational weight gain, short exclusive breast feeding (0-2 or < 2 months) and maternal smoking habits (smoker or not).

3.3.2 Study II and III

3.3.2.1 Data collection

Prior to the recruitment process for the two validation studies, we examined the most recent statistics from the yearly report of weight status of four year olds from the Stockholm Health Care Services [15]. The statistics helped us to obtain a heterogeneous sample regarding child weight status. To reach the sample we contacted school directors and heads of preschools from selected areas that were representing 45 units (30 preschools and 15 schools). Out of these, 20 preschools and 5 schools agreed to participate and questionnaires to 931 parents were distributed (595 parents of children attending preschool and 336 parents of children in the preparation year of school). The LBC, the CEBQ and the CFQ were distributed via the schools together with a questionnaire including sociodemographic data (i.e., child age, gender, country of birth and language spoken at home, parental and child weight and height) and a question of child general health. The questionnaires were sent back to the research group. To be able to examine difference between parents of normal weight and overweight or obese children, a clinical sample of 47 parents was included. The parents participated in the ML study with their preschooler. For the ML sample, children's measured weight and height, sociodemographic data and reported parental height and weight collected at baseline were used.

3.3.2.2 Definition of variables

For both studies, child and parental BMI was calculated and categorized into underweight, normal weight, overweight and obesity according to international cut-offs [1, 3, 4]. Additionally, for children BMI SDS was derived from Swedish age and gender specific reference values [5].

In Study II, children's weight categories were used to compare reported scores between groups (normal weight or overweight/obese). Sociodemographic factors used to examine correlations with the LBC factors were for children: gender, age and BMI SDS and for parents: gender, age, BMI, Nordic background (born in a Nordic country; only Sweden, Norway, Finland and Denmark were represented in the sample) and education level (university degree).

In Study III, the sociodemographic factors included child gender, age and BMI SDS as well as parent gender, age, BMI, foreign origin (born in a country other than Sweden) and education level (university degree). These variables were adjusted for in a model examining associations between child eating behaviors and parenting practices.

3.3.2.3 Description of questionnaires

The Lifestyle Behavior Checklist

The LBC was developed in Australia to measure to what extent parents perceive child problematic behaviors related to obesity in their child (the Problem scale) and how confident the parents feel in handling the problematic behaviors (the Confidence scale) [(161)]. The LBC consists of 25 items that load on four factors: Misbehavior in relation to food (e.g., the child yells about food), Overeating (e.g., the child eats too much), Emotional correlates of being overweight (e.g., the child complains about being overweight) and Physical activity (e.g., the child complains about being physically active) [(162)]. On the Problem scale, parents rate to what extent a behavior is a problem for them, from 1 (not at all) to 7 (very much). On the Confidence scale, parents rate how confident they are in dealing with the problematic behaviors, from 1 (Certain I can't do it) to 10 (Certain I can do it). If the parent has not experienced a problematic behavior, according to the instructions s/he is asked to assess his/her confidence hypothetically. The scores for the 25 questions are added to create a measure of the extent of lifestyle-specific behavioral problems, and to assess parental self-efficacy related to specific behavioral problems [(162)]. The clinical cut-off values for the Problem scale are above 50 (range = 25 to 175) and for the Confidence scale under 204 (range = 25 to 250) [(162)]. The clinical cut-offs were developed on the basis of a comparison with means from a healthy weight population (community sample) [(163)].

The Child Feeding Questionnaire

The CFQ is the most established instrument in the field of child nutrition and pediatrics to examine parental feeding practices [(164)]. The CFQ assesses parents' perceptions and concerns about child obesity, as well as their child-feeding attitudes and practices [(101)]. The CFQ consists of seven factors. The first four factors measure parents' perceptions of their own and their child's weight at different ages, and concerns parents may have that can affect how they control their child's eating. These four factors are: Perceived responsibility (3 items), Perceived parent weight (4 items), Perceived child weight (3 items) and Concern about child weight (3 items). The other three factors measure parental attitudes and feeding practices relating to Restriction (8 items), Pressure to eat (4 items) and Monitoring (3 items) [(101)].

In Study II and III, we used the Swedish version of the CFQ proven to be valid in a previous Swedish preschool population [(103)].

The Child Eating Behavior Questionnaire

The CEBQ is also a well-established instrument of child eating behavior [164] and consists of 35 items on eating styles related to obesity risk, loading on eight factors divided into two dimensions [94]. The Food approach dimension is represented by four factors: Food responsiveness, with five items (e.g. "given the choice, my child would eat most of the time"), Emotional overeating, with four items (e.g. "my child eats more when worried"), Enjoyment of food, with four items (e.g. "my child enjoys eating"), Desire to drink, with three items (e.g. "my child is always asking for a drink"). The Food avoidance dimension is represented by: Satiety responsiveness, with five items (e.g. "my child gets full up easily"), Slowness in eating, with four items (e.g. "my child finishes his/her meal quickly"), Emotional undereating, with four items (e.g. "my child eats less when upset"), and Food fussiness, with six items (e.g. "my child refuses new foods at first"). Parents rate each behavior on a five-point Likert scale (never, rarely, sometimes, often, always; 1–5) [94].

The Swedish version of the CEBQ used in Study III has previously been evaluated with EFA [165]. However, when testing a previously validated instrument in a new population CFA, a theory-driven method, is recommended [166].

3.3.2.4 Translation of the LBC

The development of the Swedish version of the LBC began with a translation process conducted according to standard recommendations [154, 167, 168] and in collaboration with the Australian developers of the instrument [161]. The LBC was translated into Swedish and then an adjusted version of the translated LBC was back translated by two other independent translators. The few differences were due to wording choice.

3.3.2.5 Cognitive interviews

To test the comprehensibility of the translated LBC, cognitive interviews [169] were performed with five parents representing the target population of parents with preschool-aged children. In the interviews, the techniques think-aloud and verbal probing were used. When using think-aloud the interviewer asks the respondent to describe how he/she reasons when answering the questions, and with verbal probing the interviewer uses questions to follow-up on the respondent's answer. Both techniques help the interviewer to better understand the cognitive processes evoked by the questions asked and the answers given [169]. The interviews followed a standardized protocol, were recorded and lasted for approximately one hour. Further minor adjustments in wording choices and concepts were added after the interviews and incorporated in the final revision of the LBC.

3.3.3 Study V

In Study V, data collected for the ML study at baseline and at 3 and 6 months follow up were used to compare the treatment effect of standard treatment and the parent-only treatment program, both described below.

3.3.3.1 Standard treatment

The families randomized to standard care received treatment based on the action plan for childhood obesity in Stockholm County [170]. This treatment commonly focuses on advice regarding healthy food to provide to the child and how to increase the child's physical activity. The families are then supported in maintaining changes made. During the first and the 12 month follow-up visits the family meets with a pediatrician. The family meets with a pediatric nurse for the remaining visits. Families can also be offered referrals to a dietician and a physiotherapist. The treatment set-up varied between clinics; for the purpose of the present study each clinic was asked to fill out a protocol at the 3 and 6 months visits documenting what treatment the family had attended and on how many occasions. A similar individual standard treatment has recently been described [171].

3.3.3.2 Parent-only program

The ML parent-only program was designed in close collaboration with the KEEP model developers [116]. Conceptual and cultural adaptations and adjustments were made to fit the Swedish population of parents with preschoolers with obesity. Each session was led by two group leaders (one leader and one co-leader) and introduced a positive parenting practice (encouragement, positive involvement, monitoring, problem solving, and limit setting strategies) with information delivered in a step-by-step fashion. Each session also included a food or physical activity related topic. To facilitate better comprehension of the presented material, practical components, such as role plays, were used. At the end of every session, a home practice assignment was presented. The parents were asked to practice the topic that had been discussed at home. The assignment was then reviewed at the beginning of the next week's session. Both parents were invited to participate and child care was provided. To increase attendance the groups were held in a location close to where most of the families lived. If parents missed a session, material was sent home and one of the group leaders called the family to review the session and answer questions [114].

The KEEP founders held the initial group leader training over five days. The training then continued through weekly supervision by a KEEP consultant using video recorded ML group sessions. After completing three supervised groups the group leader applied for certification as ML leader. After certification, the group leaders receive bi-annual fidelity checks. After co-leading two groups, a co-leader person can apply for certification after additional supervision during one group as group leader [114].

Conceptual influences

The KEEP program is based on Bandura's Social Learning Theory [172] and Patterson's Social Interaction Learning Theory [119, 173]. The theories state that children's optimal development is promoted by active family involvement. Bandura argued that humans learn through direct and indirect modelling; the behaviors are taught through direct positive or negative reinforcements to the child but also through experiences of how other's behaviors are responded to [174]. Family members' need to calibrate their behavior and improve their

interaction to develop a good understanding about responsibilities and role sharing [174]. Patterson focused specifically on the effect of interactions between family members and children; this was systematically studied during decades of direct observational studies of families [173]. Building on the social learning theory, Patterson showed the consequences of parents' behavior on children's development in his research [118]. For example, by reinforcing positive behaviors in the child and breaking the pattern of coercion (negative talk/persuasion), more positive social skills were developed [118]. Interestingly, when positive parenting practices were added to an obesity intervention targeting 8-12 year old children, weight development was better for children in families with higher levels of parental warmth [175].

However, to target the many causes of childhood obesity a wide perspective for interventions is necessary. The Ecological System Theory, developed by Bronfenbrenner [176], is therefore of equal relevance to explain how children's development is affected on multiple levels. The microlevel represents the child's immediate environments (family, preschool, etc.), the mesolevel is where the children's family, preschool, and other microlevels interact, along with exolevel (community) and macrolevel (the larger socio-cultural context) that do not involve the children directly [176]. The child's development is thus not only depending on individual factors but also on the interactions between levels.

3.3.3.3 Data collection

Child weight, height and waist circumference was measured at baseline and after 3 and 6 months by child health care professionals using calibrated instruments. All measures were repeated three times and mean values were derived. Child weight was measured with the child wearing underwear. Child height was measured using a fixed stadiometer. Child waist was measured in between the lower rib and the iliac crest using a non-extensible tape. Weight and height measurements from the child health care nurse recruiting the family to the study were used in case baseline measures were missing. Missing values could be due to the family declining participation or if baseline measures had not yet been conducted when the dataset was developed.

Sociodemographic questionnaires were filled out by each parent at baseline. One parent was asked to fill out the questionnaire for the child. Sociodemographic data included child age, gender, number of siblings and if the child was living with both parents or not. Parental characteristics included: age, gender, country of origin, language spoken at home, education level, occupation status, parental monthly income level, living in owned housing or not and weight status based on reported weight and height. Parents were classified as normal weight, overweight or obese based on WHO's cut-off criteria [1].

The primary outcome of the study was child BMI SDS derived from Swedish age and gender specific reference data [5]. The secondary outcomes were child BMI and waist circumference, reduction in BMI SDS ≥ 0.5 and maintenance of any reduction in BMI SDS from 3 to 6 months follow-up.

3.3.3.4 Evaluation of the parent-only program

Evaluation forms

To assess the parents' perceived usefulness of the program content, evaluation forms were administered and filled out anonymously during the last session. Questions were based on the KEEP program's standard evaluation forms. Parents were asked to what extent they agreed with 16 statements with the following response options (scores): not at all (1), sometimes (2), pretty much (3), completely (4) (e.g., *I have received tips on new parenting skills/strategies to use, I now use new strategies to help my child to cooperate, I have become more consistent towards my child when teaching him/her new things*). The mean score of each item for each group was calculated and mean score for the entire parent group population (Group 1-8).

Interviews

Detailed examination of content and parental acceptance of the program was assessed by interviewing a convenience sample of parents based on a variation in session attendance including both mothers and fathers. The parents interviewed had participated on average in 81% (42%-100%) of the sessions, 62% mothers and 38% fathers. The interviews were performed approximately 6 months after the parent group ended by researchers not involved in the parent group. The interviews were conducted over the telephone following a semi-structured interview guide. The interviews lasted for approximately 30 minutes and were recorded and then transcribed. For the analysis of the interviews thematic analysis was used described under Comments on statistical methods.

3.4 STATISTICAL METHODS

In all studies, the descriptive statistics are presented as means and standard deviations (SD), or numbers and percentages for categorical data. Independent sample t-tests (for continuous variables) and chi square tests (for categorical variables) were used. Variables were checked for normal distribution by visual inspection of histograms and boxplots. All p-values < 0.05 were regarded as statistically significant. See Table 1 for all statistical methods used.

Table 1. Statistical methods used in the studies.

	Study I	Study II	Study III	Study V
Descriptive statistics	x	x	x	x
Independent sample t-test	x	x	x	x
Chi square test	x	x	x	x
Linear regression	x			
Logistic regression	x			
Confirmatory factor analysis		x	x	
Exploratory factor analysis		x		
Cronbach's alpha		x	x	
Structural equation modelling		x	x	
Linear mixed models				x

3.4.1 Main analyses

Study I

In linear and logistic regression models we examined associations between child BMI SDS at 3, 6 and 12 months and rapid weight gain between birth and 6 months (dependent variables) and parental BMI and parental education level (primary exposure variables). In adjusted models we included gender, birth weight, short exclusive breastfeeding, maternal gestational weight gain and maternal smoking to explore the possible influence of these factors.

Study II

EFA was used to replicate the original 4-factor structure and to guide the further testing of the factor structure with CFA. Independent samples t-tests were used to compare scorings between groups according to children's weight status (normal weight or overweight/obese). The construct validity of the LBC was obtained by examining the correlations between the

LBC and the CFQ's factors using structural equation modeling (SEM). SEM was also conducted to examine the associations between the LBC and sociodemographic factors (child gender, age and BMI SDS and parental gender, age, BMI, Nordic background and education level).

Study III

CFA was used to test the original 8-factor structure of the CEBQ. To examine associations between child eating behaviors and parental feeding practices, SEM was conducted. The model included five CFQ factors (Restriction, Pressure to eat, Monitoring, Perceived responsibility and Concern for child weight) regressed on the CEBQ subscales Food approach and Food avoidance and child (gender, age, BMI SDS) and parental characteristics (gender, age, BMI, foreign origin and education level), as well as on the LBC Confidence scale. The CFQ factor Concern for child weight and Perceived responsibility were used as mediators in the model. Effect sizes and correlations were assessed according to Cohen (0.1–0.3 weak; 0.3–0.5 medium, 0.5–1 strong) [177].

Study V

Independent samples t-test and Chi-squared tests were used to analyze differences between outcome variables and sociodemographic variables at baseline for standard treatment and parent group treatment and to compare participants and those lost to follow-up for the total population and by group. To examine the difference in treatment effects between the parent-only program and standard treatment on primary (BMI SDS) and secondary outcomes (BMI and waist circumference) at 3 and 6 months follow-up linear mixed model analyses were used. The main models included the variables: time (months), treatment group and their interaction (time by group). Random intercept and a random slope for time were used. In the adjusted models the following variables were included: child age at baseline, gender, family structure (first born, child living with both parents or not), parental BMI and SES (parental income and education level), as well as attendance to obesity treatment. Risk ratios (RR) were calculated to compare clinical significance of treatment effect (i.e., reduction of BMI SDS $\geq$ 0.5) and maintained reduction in BMI SDS from 3 to 6 months between the two treatment groups.

Complete case analyses using all available data was the main analysis for this study because it was important for us to see the results of the children who had attended treatment. However, according to intention-to-treat principles, additional analyses were made where missing follow-up values and missing values on baseline covariates were imputed simultaneously using multiple imputation with chained equations (m (number of imputations) = 10).

To evaluate if the treatment effect was moderated by any of the baseline covariates, three way interactions with BMI SDS as dependent variable were conducted. If a significant interaction

was identified, for categorical variables, linear mixed model analyses were conducted separately for the groups in question. Only significant interactions were reported.

The statistical analysis were conducted in STATISTICA, version 10 (StatSoft, Inc., Tulsa, OK, USA, http://www.com), SPSS Statistics, version 20 and 22 (IBM, Armonk, NY, USA, http://www.ibm.com) and in Mplus, version 7.11 (Muthén & Muthén, Los Angeles, CA, USA, https://www.statmodel.com).

3.4.2 Comments on statistical methods

Below are short descriptions of concepts and methods used in the studies.

3.4.2.1 Construct and discriminative validity

In Study II, the construct validity and the discriminative validity of the LBC was tested. Construct validity can be divided into convergent and discriminant validity. By testing convergent validity we want to see how the questionnaires conform to other instrument that measure related behaviors (e.g., a child perceived as eating too much and parental restriction). Discriminant validity, on the other hand, tests if measures that are supposed to be unrelated are in fact unrelated [154].

For discriminative validity, on the other hand, you want to be able to detect a difference in the responses of different groups (e.g., parents of overweight and obese children reported higher scores on obesity related behaviors than parents of normal weight children) [154].

3.4.2.2 Internal reliability (Cronbach's alfa)

In Study II and III, the internal reliability measured by Cronbach's alpha was conducted. Internal reliability shows how well items in an instrument correlate. Cronbach's alpha can obtain a value between -∞-1 but an acceptable level of homogeneity is 0.7. If Cronbach's alpha is 1 it means that all items measure the same thing [154].

3.4.2.3 Factor analyses

In Study II and III, the factor structures of the LBC and the CEBQ were obtained by using EFA and CFA. EFA is a commonly used analysis to assess factor structure of new instruments when no prior structure has been reported. The factor structure is determined by examining factor loadings (e.g., what items in the questionnaire correlate to each other and load upon the same factor or scale). Acceptable factor loadings are > 0.4. EFA is data driven compared to the theory driven CFA when a hypothesis about what items are correlated to each other already exists [166]. Data from the new population is then applied upon the original factor structure. In other words, the researcher shapes the data into an expected structure and evaluates whether such structure, or fit to the model, is acceptable. To evaluate the fit of the factor structure after CFA four fit indices are commonly recommended: the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR). Adequate fit is indicated by

CFI and TLI values over 0.90 [158] and good fit is indicated by values over 0.95, a RMSEA of 0.06 or lower and a SRMR of 0.08 or lower [178].

3.4.2.4 Structural equation modelling (SEM)

In Study II and III SEM was used to examine associations and to create a model for the direct and indirect effects of child eating behaviors on parental feeding practices. SEM conducted using full information maximum likelihood (FIML) with robust standard errors is a more efficient way of analyzing data compared to listwise deletion, because we can incorporate individuals with partially missing information into the analysis. By analyzing associations between latent variables with SEM, rather than associations between observed variables with ordinary regression, we allow measurement error in independent, as well as dependent, variables [179]. SEM is also very useful when analyzing mediated effects.

3.4.2.5 Linear mixed models analysis

In Study V linear mixed models analysis were used to examine the difference in treatment effect between groups. The method allows for examination of longitudinal data collected at more than two time points and allows adjustment for factors that may influence the effects. Also, the use of random intercept and a random slope for time let us assume that the children have different weight status at baseline and that the effect of time differs. Restricted maximum likelihood (REML) was used in the analysis which compensates for biased estimates for small samples [180].

3.4.2.6 Thematic analysis

Thematic analysis was used to analyze the interviews conducted with the parents who had participated in the ML parent program. The entire recorded material was read, reread and coded to identify patterns (themes) through an inductive approach [181]. The inductive approach implies finding themes brought up by the parents during the interviews and not looking for themes predefined by the researcher [181]. A theme is something that is relevant to the overall research question used, not necessarily depending on the prevalence in the material [181]. In the present analysis we used a semantic approach (i.e., what the parents shared was interpreted) as opposed to the latent meaning (i.e., the interpreted underlying meaning) of what is being said [181]. Thematic analysis is a flexible qualitative research method not tied to a specific theory [181].

3.5 ETHICAL APPROVALS

Ethical approvals were granted by the Stockholm Regional Ethical Review Board for: the Early STOPP (Study I) (dnr: 2009/217-31; 2009/754-32); the validation studies (Study II and III) (dnr: 2013/486-31/2) and the More and Less study (Study IV and V) (dnr: 2011/1329-31/4; 2012/1104-32; 2012/2005-32; 2013/486-32; 2016/80-32).

4 RESULTS

4.1 STUDY POPULATIONS

In Table 2 the characteristics of study populations are presented.

4.2 STUDY I – INFANT GROWTH AND ASSOCIATIONS WITH PARENTAL BMI AND EDUCATION LEVEL

In this longitudinal retrospective study, we compared infant growth (BMI SDS at 3, 6 and 12 months and rapid weight gain from 0-6 months) between children with a higher and lower risk of developing obesity based on parental weight status (BMI) and parental education level, adjusting for the influence of known early-life risk factors for childhood obesity.

In the total population, 52% of the children were girls, mean age was 1.0 (SD 0.8) year and mean BMI SDS was -0.4 (SD 1.1). For parents mean age was 34.9 (SD 4.2) years, mean BMI was 28.7 (SD 5.1), 54% had a university degree and 13% were born in a non-Nordic country.

In the high risk group that was based on parental BMI, short exclusive breastfeeding was significantly more prevalent compared to the low risk group (33% vs. 8%; $p < 0.001$). Gestational weight gain was significantly higher in mothers with lower educational level (16.9 kg) compared to those with a high educational level (14.3 kg) ($p = 0.02$).

There was no association between the children's BMI SDS at 3, 6 and 12 months and parental BMI in the unadjusted or adjusted models. However, in the fully adjusted model (gender, child birth, gestational weight gain, short exclusive breastfeeding, maternal smoking, parental BMI and parental education), the association between the child's BMI SDS and parental education was significant at 3 months ($p = 0.02$) and at 6 months ($p = 0.04$) and significantly indicated at 12 months ($p = 0.06$). In total, 18%, 14% and 11% of the variance in BMI SDS at 3, 6 and 12 months, respectively, could be explained by the factors included in the model.

No associations could be seen between rapid weight gain and high/low obesity risk.

Birth weight was significantly and positively associated with BMI SDS at all ages ($p < 0.0001$ at 3 and 6 months and $p = 0.001$ at 12 months) and negatively associated with rapid weight gain ($p < 0.001$; OR = 0.86, 95% CI 0.79–0.93).

Maternal smoking was significantly and positively associated with BMI SDS at 12 months. The variables not included in the final models (maternal age, gestational age, introduction of solid foods and antibiotics during the first year) did not affect the associations between the child's growth development and parental BMI and education level.

Table 2. Population characteristics for the children in all studies.

	Study I				Study II and III		Study V	
	Parental BMI		Parental Education		School sample	Clinical sample	Parent-only treatment program	Standard treatment
	High risk	*Low risk*	*High risk*	*Low risk*				
n	144	53	57	139	431	47	88	88
Child	mean (SD) or n (%)							
Age (years)	1.0 (0.1)	1.0 (0.1)	1.0 (0.1)	1.0 (0.1)	5.5 (1.0)	5.1 (0.7)	5.2 (0.9)	5.3 (0.7)
Gender (girl)	70 (49)	32 (60)	31 (54)	71 (51)	224 (52)	25 (53)	42 (47.7)	56 (63.6)
Weight (kg)	10.3 (1.4)	10.0 (0.9)	10.3 (1.4)	10.2 (1.2)	19.9 (3.8)	28.3 (4.7)	29.6 (5.1)	29.3 (5.6)
Height (cm)	76.4 (3.1)	76.1 (3.0)	76.0 (3.1)	76.5 (3.1)	112.4 (9.5)	115.3 (7.1)	117.2 (7.4)	117.8 (6.7)
BMI	17.6 (1.6)	17.3 (1.2)	17.8 (1.7)	17.4 (1.4)	15.7 (1.3)	21.1 (1.8)	21.6 (1.9)	21.2 (1.7)
BMI SDS	-0.37 (1.2)	-0.49 (0.9)	-0.16 (1.2)	-0.52 (1.1)	-0.2 (1.0)	3.1 (0.7)	3.2 (0.7)	3.0 (0.7)

4.3 STUDY II – VALIDATION OF THE LBC AND ASSOCIATIONS WITH CHILD AND PARENTAL CHARACTERISTICS

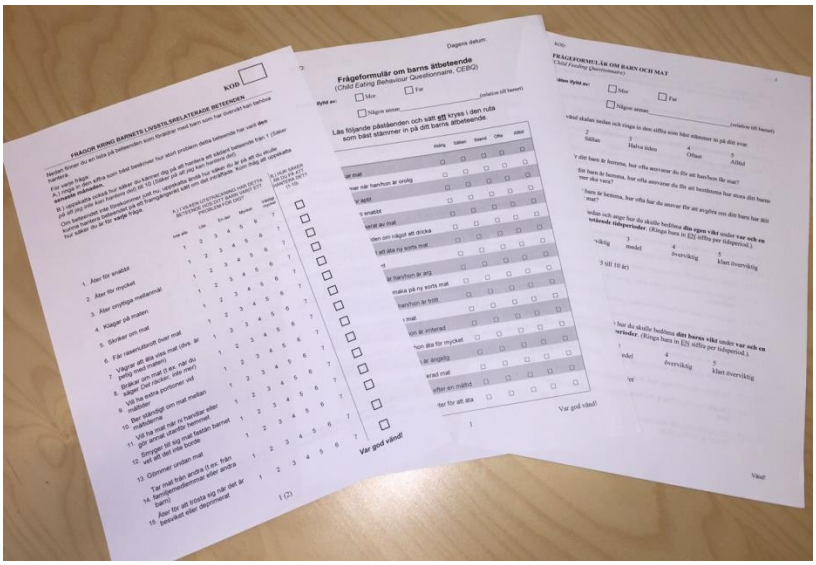
In Study II the factor structure of the LBC was tested in a Swedish sample of parents of preschoolers. To test the validity correlations between the LBC and the CFQ were assessed. Further, the difference in reports of parents of normal weight children and parents of overweight and obese children were also examined.

In the total sample (n = 478), the parents were on average 38.9 (SD 5.1) years old, 70% had a university degree and 13% were born in a non-Nordic country, mean BMI 24.0 (SD 3.8) was; 69% were of normal weight and 31% were overweight or obese. Among the children mean age was 5.5 (SD 1.0) years and mean was BMI SDS 0.2 (SD 1.4), 80% were of normal weight, 10% were overweight and 10% were obese.

4.3.1 Factor structure and internal reliability

4.3.1.1 The LBC Problem scale

A modified five factor structure proved best fit to data (TLI = 0.899; CFI = 0.918; RMSEA = 0.042; SRMR = 0.055). The fit was obtained by excluding six items (3, 4, 7, 13, 23 and 24) and allowing two pairs of error terms to correlate (Figure 1). The internal reliability assessed by Cronbach's alpha for the total Problem scale (0.85) and for the individual factors was adequate: Overeating (9 items) 0.82, Physical activity (3 items) 0.86, Emotional correlates of being overweight (3 items) 0.65, Misbehavior in relation to food (2 items) 0.71 and Screen time (new factor with 2 items) 0.73.



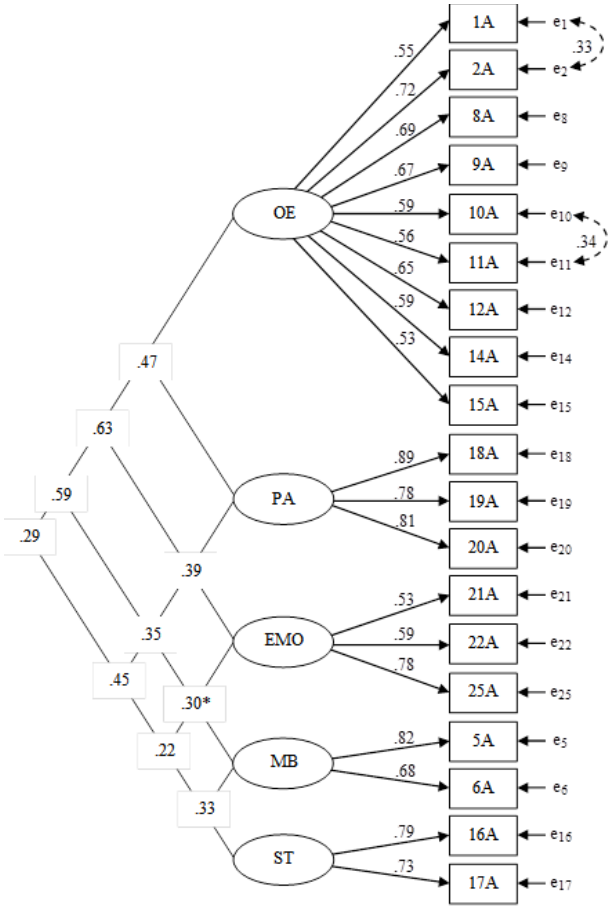


Figure 1. Confirmatory factor analysis of the Problem scale of the Lifestyle Behavior Checklist. The Problem scale of the Lifestyle Behavior Checklist (LBC) with five factors and two added correlations between error terms. The LBC five order factors in the model are: Overeating (OE), Physical Activity (PA), Emotional correlates of being overweight (EMO), Misbehavior in relation to food (MB) and Screen Time (ST). The estimates on the left side in the figure stand for correlations between the factors and the estimates on the right side of the figure stand for factor loadings.

4.3.1.2 The LBC Confidence scale

The Confidence scale indicated unidimensionality which was supported by very high internal reliability (Cronbach's alpha 0.98). Furthermore, when the same model as used for the Problem scale was fitted to the Confidence scale, all factors were highly correlated (all rs > 0.57). Therefore, a hierarchical CFA with 5 first order factors and one second order factor was tested, showing acceptable fit to data (TLI = 0.927; CFI = 0.937; RMSEA = 0.065; SRMR = 0.042) (Figure 2).

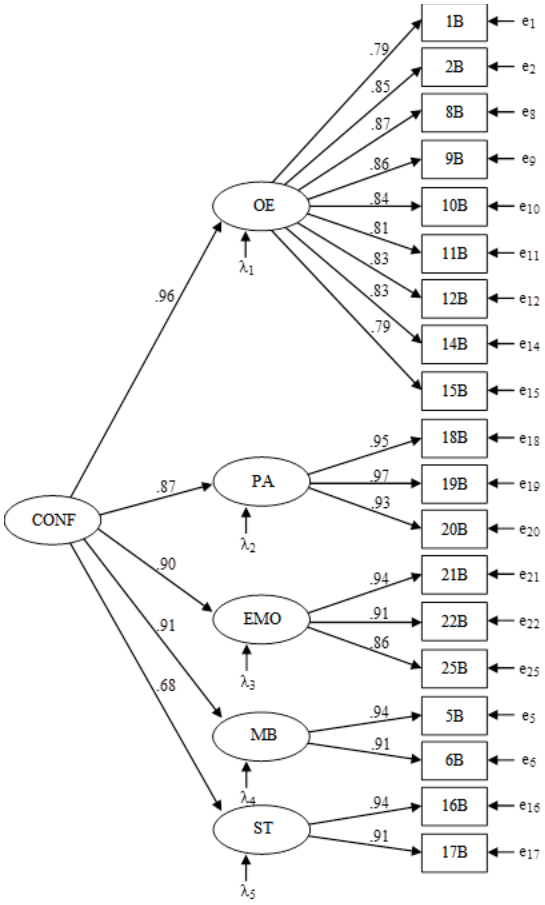


Figure 2. Confirmatory factor analysis of the Confidence scale of the Lifestyle Behavior Checklist. The Confidence scale of the Lifestyle Behavior Checklist (LBC) with five first order and one second order factor. The LBC five first order factors are: Overeating (OE), Physical Activity (PA), Emotional correlates of being overweight (EMO), Misbehavior in relation to food (MB) and Screen Time (ST) and the second order factor is Confidence (CONF). The estimates on the left side of the figure stand for standardized regression coefficients when the first order factors are regressed on the second order factor. The estimates on the right side of the figure stand for factor loadings.

4.3.2 Construct validity

The SEM model confirmed the validity of the LBC by showing expected correlations between the LBC scales and the CFQ factors. Parents who scored high on the LBC Problem scale also scored high on the CFQ factors Restriction and Concern about child weight. Parents with lower scores for Screen time-related problem behaviors reported higher scores on the CFQ factor for Monitoring of their child's eating. High scores on the Overeating factor and the Emotional correlates of being overweight factor were significantly associated with the CFQ factor Perceived responsibility. The CFQ factor Perceived parent weight was significantly correlated only to the LBC factor Overeating on the Problem scale. The CFQ factor Pressure to eat was negatively correlated to overeating on the LBC Problem scale and to the Confidence scale. High scores on the Problem scale were all correlated with lower confidence in handling obesity-related behaviors. High scores on the Confidence scale were negatively associated with the CFQ factors Concern about child weight, Restriction and Pressure to eat.

4.3.3 Discriminative validity

We proved discriminative validity by examining group means for all of the individual items of the Problem scale and the Confidence scale that were compared between parents of children with normal weight and parents of children with overweight or obesity. The total mean scores on the Problem scale for parents of children with normal weight (40.5 (SD 10.1)) were significantly lower ($p < 0.001$) than those for parents of children with overweight or obesity (53.2 (SD 18.1)).

On the Confidence scale, no significant difference was observed between the two groups' total scores.

4.3.4 Associations between the LBC and socio-demographic variables

The child's BMI SDS was the variable most strongly and significantly associated to all LBC factors on the Problem scale except for Screen time. Screen time was significantly associated to child age ($\beta = 0.2$, $p < 0.001$) and to child gender (girl) ($\beta = -0.37$, $p < 0.05$). Mothers were less likely to report problem behaviors related to physical activity ($\beta = -0.35$, $p < 0.05$).The Confidence scale was not significantly correlated with any of the studied child or parental variables.

4.4 STUDY III

In Study III the factor structure of the CEBQ was tested and confirmed in a Swedish sample of parents of preschoolers (see description of sample characteristics under Study II). The effects of child eating behaviors on parental feeding practices were analyzed with SEM. In summary, parents reported higher levels of pressure to eat for children perceived to have a small appetite. Parents did not use restrictive feeding practices for a child with a large appetite unless they were concerned about the child being overweight.

4.4.1 Validation of the CEBQ

The CFA of the CEBQ demonstrated an acceptable fit for a modified 8-factor structure (TLI = 0.91, CFI = 0.92, RMSEA = 0.05 and SRMR = 0.06) after dropping item 30 ("my child cannot eat a meal if s/he has had a snack just before"). Three pairs of error terms were allowed to correlate as this resulted in a substantial improvement in model fit. The internal consistency was adequate for all factors (Cronbach's alphas above 0.7).

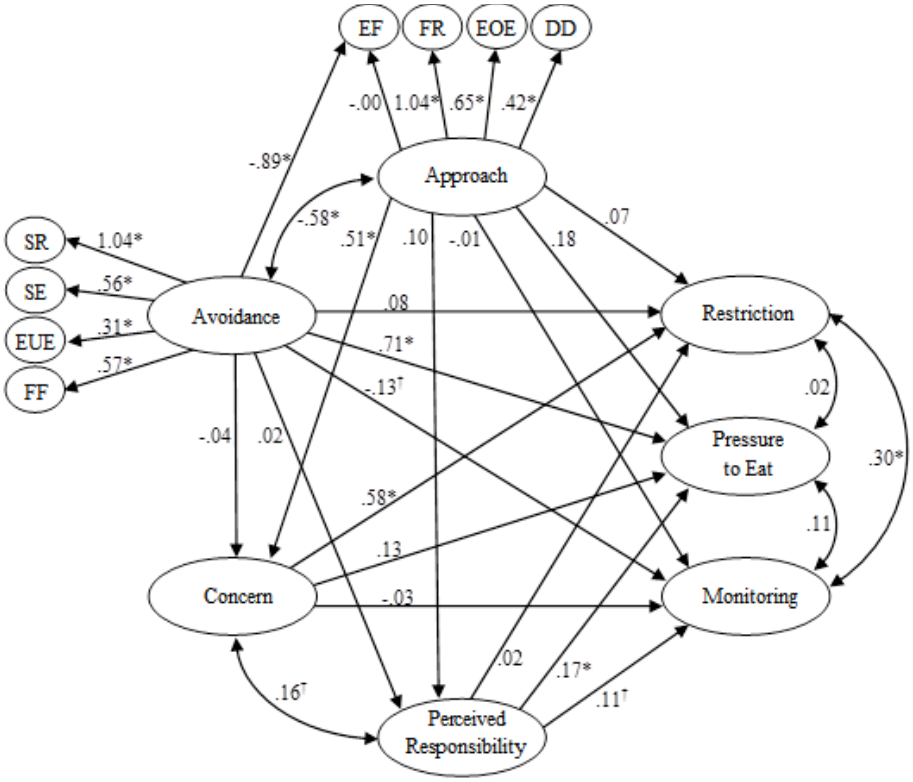


Figure 3. A structural equation model of child eating behaviors and parental feeding practices. The model shows associations between child Food approach and Food avoidance and parental Restriction, Pressure to eat, and Monitoring, with Concern and Perceived responsibility as mediators. The effects (standardized) are adjusted for the effects of child age, gender and body mass index standard deviation score and for parental age, gender, body mass index, Nordic origin and university degree and parental life-style specific Confidence.

4.4.2 Child eating behaviors and parental feeding practices and concerns

There was a strong positive direct effect of Food avoidance on Pressure to eat ($\beta = 0.71$; $p < 0.001$). Food approach did not have any strong or significant direct effects on parental feeding behaviors but a moderate ($\beta = 0.30$) indirect effect on Restriction via Concern, which resulted in a substantial total effect ($\beta = 0.37$). The independent predictive effect of Food approach on parental Concern was strong ($\beta = 0.51$, $p < 0.001$) as well as the direct effect of Concern on parental Restriction ($\beta = 0.58$, $p < 0.001$).

4.4.3 Associations of child and parental characteristics

Food approach had its strongest correlation with child's weight status (BMI SDS) ($r = 0.58$, $p < 0.001$). Food avoidance was significantly correlated only with child's BMI SDS ($r = -0.40$, $p < 0.001$). Child BMI SDS also had a moderate independent predictive effect on parental Concern ($\beta = 0.33$, $p < 0.001$).

4.5 STUDY V – TREATMENT EFFECTIVENESS AND EVALUATION OF THE ML PARENT-ONLY PROGRAM

In Study V, treatment effectiveness of a parent-only treatment program was compared to standard care for obesity in preschoolers.

In total, 336 children were referred to the study and 177 were randomized to the parent group (n = 89) and to standard treatment (n = 88). One child from the parent group was excluded from the analysis due to receiving a diagnosis during the study that could affect the child's physical development. In the total population, children were on average 5.2 (SD 0.8) years, 56% were girls, mean BMI was 21.4 (SD 1.8), BMI SDS was 3.2 (0.7), 49% were the first born child and 80% lived with both parents. Mothers were on average 36.6 (SD 5.6) years, 57% of foreign background, 39% had a university degree and average BMI was 28.2 (SD 5.7) (32% normal weight, 37% overweight and 31% obese). Fathers were on average 39.9 (SD 7.3) years, 57% of foreign background, 40% had a university degree and average BMI was 29.5 (SD 4.5) (11% normal weight, 51% overweight, 38% obese).

There was no difference in any baseline characteristics between the two treatment groups except for child gender (p = 0.034). In the total population, the lost to follow-up was 22%, 32% in the parent group and 13% in the standard treatment group (p = 0.003). There was no difference in baseline characteristics between participants and those who were lost to follow up for the total population and for those randomized to standard treatment. In the parent group, the families who did not complete the study only differed in mothers' occupation status (p = 0.04); mothers who dropped out were more likely to be on maternity leave or in school and less likely to have a full-time or part-time job. The attendance rate for the parent group was on average 67% (average number of visits at 3 months, 7.3 (SD 3.3) and at 6 months 7.8 (SD 3.7). However, 77% of parents participated in more than half of the program sessions and 17% attended less than 3 sessions. In 56% of the families both mothers and fathers participated in the group sessions together on at least one occasion. In 20% of the families, only mothers participated and in 20% of the families only fathers participated. The less common combination included participation of mother, father and other family member (2% of families) and in 2% mother and new partner participated. For standard treatment the mean number of visits at 3 months was 2.2 (SD 1.55) and at 6 months, 3.9 (2.3). The reasons for declining participation in the study that parents cited most often were work-related (inflexible work hours and travel), family situation (having an infant, going through a divorce, not being able to find child care, having other activities scheduled (for the parent group)) or that the child had lost weight.

While the complete case analysis was our primary analysis, in Figure 4 we also present the results of both complete case and intention-to-treat analysis with imputed values for BMI SDS, BMI and waist circumference. The results of the linear mixed model analyses showed a significant difference in the effect of time between the groups (p < 0.001 for all outcomes). Improvements were seen for all outcomes for the parent-only group while no decrease was seen for any outcome for standard treatment. The mean change in BMI SDS for the children in the parent group was – 0.21 after 3 months and – 0.42 after 6 months. For the children in standard treatment, there was a slight increase in BMI SDS of 0.01 after 3 months and 0.02 6 months post baseline.

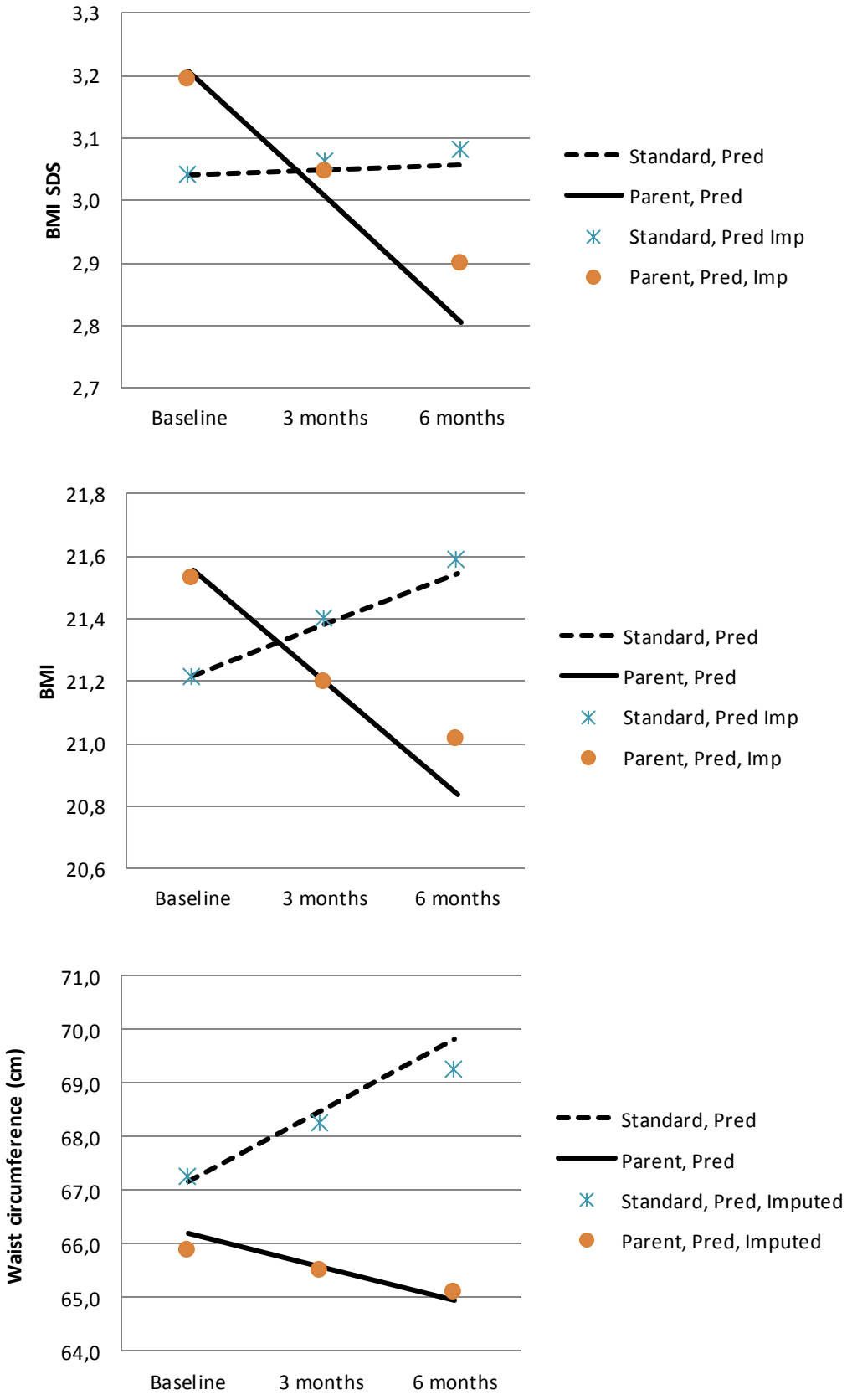


Figure 4. Mean Body mass index standard deviation scores (BMI SDS) (primary outcome), BMI and waist circumference at baseline, 3 and 6 months follow up. Predicted and predicted with imputed values (imputed) presented by study group (standard treatment and parent group) ($p < 0.001$).

The advantage of being in the parent-only group, as compared with the standard treatment, was greater for children with a Swedish mother and with parents with a university degree, as compared to children with a mother of foreign origin and parents without a university degree. See Table 3.

Table 3. Mean body mass standard deviation score (BMI SDS) and difference from baseline to 3 and 6 months follow-up by treatment group for parents with and without foreign background and university degree.

	Parent-only group					**Standard treatment**				
	Baseline	3 m	*diff.*	6 m	*diff.*	Basline	3 m	*diff.*	6m	*diff.*
Significant interaction variable										
Mother										
Foreign background										
[a] Yes	3.34	3.26	– 0.09	3.17	– 0.17	3.09	3.12	0.03	3.15	0.06
[b] No	2.99	2.67	**– 0.32**	2.35	**– 0.64**	2.98	2.98	**– 0.003**	2.97	**– 0.006**
University degree										
[c] Yes	2.91	2.56	**– 0.35**	2.21	**– 0.70**	2.94	2.96	**0.02**	2.98	**0.04**
[d] No	3.34	3.23	**– 0.11**	3.12	**– 0.22**	3.12	3.13	**0.01**	3.14	**0.02**
Father										
University degree										
[e] Yes	2.83	2.48	**– 0.35**	2.13	**– 0.70**	2.86	2.91	**0.05**	2.96	**0.10**
[f] No	3.28	3.16	– 0.12	3.04	– 0.24	3.16	3.14	– 0.02	3.12	– 0.04

Note: Bold print indicate a significant difference in treatment effect between parent group and standard treatment.
Diff: mean difference from baseline
[a] Linear mixed model coefficients: BMI SDS (intercept: 3.09**; treatment group: 0.253; time (month): 0.010; group by time: - 0.039)
[b] Linear mixed model coefficients: BMI SDS (intercept: 2.98**; treatment group: 0.007; time (month): - 0.001; group by time: - 0.105**)
[c] Linear mixed model coefficients: BMI SDS (intercept: 2.94**; treatment group: -0.026; time (month): 0.006; group by time: - 0.123**)
[d] Linear mixed model coefficients: BMI SDS (intercept: 3.12**; treatment group: 0.218; time (month): 0.004; group by time - 0.040*)
[e] Linear mixed model coefficients: BMI SDS (intercept: 2.86**; treatment group: - 0.033 ; time (month): 0.016; group by time: - 0.133**)
[f] Linear mixed model coefficients: BMI SDS (intercept: 3.16**; treatment group: 0.117; time (month): - 0.006; group by time:- 0.034)
** $p < 0.001$, * $p < 0.05$

The RR for children in the parent group to have a decrease of ≥ 0.5 in BMI SDS was 3.43 (CI 95% 1.50-7.86) after 3 months and 4.56 (CI 95% 1.85-11.26) after 6 months compared to children receiving standard treatment. RR for a decrease in BMI SDS < 0.5 was 0.68 (CI 95% 0.53-0.88) at 3 months and 0.62 (CI 95% 0.47-0.83) at 6 months follow-up for the parent group treatment compared to standard treatment. The RR for maintaining any reduction of BMI SDS from 3 to 6 months follow-up was 2.32 (CI 95% 1.46 - 3.68) in the parent group compared to standard treatment. The RR for not maintaining a reduction in BMI SDS was 0.40 (CI 95% 0.23-0.69) for the parent group compared to standard treatment.

4.5.1 Process evaluation

4.5.1.1 Evaluation forms

All participating parents filled out the evaluation forms in four out of the eight groups. The mean scores (0-4, higher score indicates higher satisfaction) and attendance rate for each group are presented in Table 4. Total mean score for the parent group population was 3.5.

Table 4. Mean group scores of the parent-only group program evaluation (score range 0-4, higher score indicates higher satisfaction) and attendance rate.

Group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Mean Score	3.4	3.9	3.0	3.3	3.4	3.3	3.7	3.7
Attendance (%)	100	80	64	56	60	100	100	100

4.5.1.2 Interviews

Interviews from 21 parents from the first five parent groups were included in the analysis. The interviews were conducted six months after the end of the intervention. The parents interviewed had participated on average in 81% (range, 42% -100%) of the sessions.

Five themes were identified: eye-opener, reminder, change, uncomfortable and suggestions for improvement. The first three themes identified positive components of the program contributing to lifestyle changes and parenting support. The two last themes are components of the program that the parents perceived as difficult to try out and included therefore suggestions to modify. See Table 5 for the identified themes and related parental quotes.

Supplementary Table 6 Results from thematic analysis, themes identified and quotations from participants.

Themes	Quotations
Eye-opener	”… it has been a great insight into what food children really need and the importance of physical activity…”
	”Just to see that others also have problems and found it hard made it less hard for one-self.”
	”It clarifies how a situation really is when role-playing. Sometimes it becomes hilarious and you think, oh God is this how it actually is, but yes, it actually is and then it becomes an eye-opener.”
	”… the tips about serving a small portion and if they want another they get another small portion if you know they always ask for seconds, or don’t put the pots on the table just the portions that they should eat, all those tips…”
	”What stuck with me is that when the children are a little rowdy that you should try to ignore it and not fight back. It has actually worked and I am a little surprised about that.”
	“There were many good tips, both from other parents and from the group leaders. Some things that we learned were really good, it felt great. …That we should reward instead of punish, for example that “if you do this you will get a star”, it was just a lot of different alternatives and input on how to reward. Of course we also got good practical information about setting limits, how much can you eat in a week, what is a good amount of candy -“intake” or calorie intake.”
Reminder	”I think I was quite consistent before but you now understand the importance of it.”
	”There were many thing you know but it is good to be reminded of. You realize when you try, that you don’t have to end up in a fight with your child just because you say no.”
	”It has empowered me … I have been reinforced in what I have been thinking, that I want us to have this approach to things, the discussions and the input have strengthen me, confirmed that I was on the right track. That was nice.”
	”… I have gained a better insight to how it is to be a parent and been given tools to keep the good food habits that we now have established.”
Change	“After we started changing the way we buy food the results have been great. My son is happier, little lighter, he sleeps better and longer.”
	“We have changed his lifestyle, definitely, it was also one of those things that were very easy, just changing these things, you know. Like, he gets used to it fast, children adapt quickly. I think you learn quite fast to go from drinking milk to drinking water, from eating white bread to dark bread … from normal to wholegrain and for children it goes even faster.”
	”Yes, I have become stricter towards him, what is ok and what isn’t and he has noticed the change and he can now say: But it is not Saturday today. We can’t have sweets today.”
	”It took a whole summer for us to change because we were so set in our ways.”
	”The social situations have been the hardest … that there are so much sweets and ice-cream around kids with no weight problems, and try to get our child not to eat too much. Try to avoid these situations.”
	”I have set aside more time in the morning so that she can cycle to and from school every day instead of us taking the car ... that was the first change we made.”
	“It is important that both parents are involved just as much, so they understand that I don’t make this up. And that the whole family is involved, it’s not just the small child who has this problem.”
Uncomfortable	***What the program would focus on***
	“I was worried in the beginning that the focus was on the children’s weight.”
	Role plays
	“It’s not my thing (role plays) I can tell you that. I don’t go to a course to play but to learn. I rather watch a film clip and discuss that …”
	”It can be good but it is hard if you have a threshold to get passed before it feels comfortable.”
	Rewards
	”Because we thought it was a bit scary that the children learned that they would get a reward as soon as they did something, … as soon as we asked him to do something he came back and asked what reward he would get.”
	Involving the preschool
	”I was overweight my whole life and my parents had periods when they realized I gained too much weight so they became quite strict with me. These moments have stuck with me in a negative way my whole life, in childhood, in the adolescent years and now as adult. I had a lot of prejudice not to eat in front of others, yes I had a lot of anxiety, not just appearance wise but how I act. So that I didn’t want my four year old son to get… Therefore I didn’t want to contact the preschool…I now feel more confident to go to the preschool and talk about it.”
Suggestions for improvement	”Maybe that you could get information to give o the preschool; this is what we are doing …”
	”…more of the psychosocial parts for the child, or when they hear from other that they are chubby and what you can say to other children who say things that are not ok and such”
	”The only thing you could do anything about was number of participants. We were not enough (participants).”
	”Try to cut down on number of sessions and comprise the program a bit instead. Then you might be able to attract more (families).”

5 DISCUSSION

5.1 MAIN FINDINGS

In a series of articles this thesis highlights the importance of the parents in the prevention and treatment of preschool obesity – as both a risk factor and a unique resource. Additionally, two instruments were validated in this thesis. Valid and reliable instruments for measuring obesity-related behaviors can help guide health care professionals in the type of support to offer parents, thus enabling further optimization of obesity interventions.

Study I showed that parental education level was associated with child weight development during the first year of life, but not to parental weight status. Neither parental education level nor BMI were associated with rapid weight gain. No previously identified early risk factors for obesity could explain these associations.

In Study II, a modified 5-factor version of the LBC proved to be a valid instrument to use in a Swedish population of parents of preschoolers. The LBC measures obesity-related behaviors in children (Problem scale) and parents' confidence in handling these behaviors (Confidence scale). The validity of the LBC was proven meaningful by relevant correlations between obesity-related problem behaviors and parent feeding practices and child BMI SDS. Further, high scores on the Problem scale correlated to low scores on the Confidence scale. There was also a significant difference in how parents of children with normal weight and parents of children with overweight and obesity responded to the LBC Problem scale, providing further evidence for validity of the LBC.

In Study III, the factor structure of the CEBQ measuring child eating behaviors was tested. A modified version of the original 8-factor structure proved best fit to the data. A second aim was to present a model examining the effects of child eating behaviors on parental feeding practices. Parental perception of children's small appetites was strongly associated with the use of pressure to eat. Parental concern about children's overweight, on the other hand, was more strongly associated with restrictive feeding practices than children's large appetites.

In Study V, a parent-only program for preschool obesity treatment outperformed standard treatment regarding change in BMI SDS, BMI, and waist circumference. No treatment effect was seen in children in the standard treatment group. The children in the parent-only group were more than three times more likely to have a clinically significant decrease in BMI SDS after 3 months, and more than four times more likely after 6 months. Further, children in the parent-only group were also twice as likely to maintain any reduction in BMI SDS from 3 to 6 months follow up. Higher parental education level led to a better treatment effect in the parent-only group. However, the children in the parent-only treatment group had a significantly larger reduction in the primary outcome measure (BMI SDS) compared to standard treatment regardless of parental education level. The qualitative and quantitative evaluation of the program showed that feasibility, acceptance and relevance of the program components were very high.

5.2 ARE EARLY INTERVENTIONS FOR OBESITY MEANINGFUL?

All studies focused on the preschool age group, both in relation to child weight development (Study I and V) and in relation to obesity-related behaviors, and to associated parenting practices (Study II and III). Below I reflect on the positive aspects of early interventions for obesity as well as the possible challenges for child health care.

The first Cochrane reviews in the field of childhood obesity have all called for more attention to the preschool age group for the prevention and treatment of obesity [76, 182]. The potency of early initiatives is the capacity to target known risk factors of later obesity and to halt the establishment of unhealthy family lifestyle habits [183, 184]. Treatment interventions in the preschool age group are still in its infancy, with only seven RCT treatments included in the latest Cochrane review [136]. More studies specifically targeting preschoolers are now being performed and will increase our knowledge in the field [136]. The increased interest in early treatment initiatives has been motivated by longitudinal studies showing better treatment effects than those introduced later in childhood [131, 132]. It is difficult to directly compare the results from Study V to other studies due to differences in the study designs, specifically related to the control groups, populations and treatment set-ups. However, our results on the primary outcome (BMI SDS – 0.42) after 6 months are comparable to other successful interventions [137, 139-141]. The most successful early interventions are, like ML, intensive and multidisciplinary, and offer supportive behavioral managing tools to parents [135, 136]. The importance of intensity was supported in Study V where higher attendance in both the parent-only treatment and standard treatment was associated with a larger decrease in BMI SDS. The importance of intensive treatments is a challenge for the pediatric clinics, which often offer low-intensity obesity treatments with 4-8 visits per year [135, 171]. When assessing the feasibility and cost-effectiveness of more intense treatments in standard care attrition rates, often related to obesity treatment, need to be considered [185].

The preschool age does seem appropriate for early interventions but what is this period of life like for parents? Many parents express a desire to change their lifestyle so that their child will grow up with healthy habits. However, we know that this is also one of the most stressful periods in parenthood, making lifestyle changes difficult [186]. Designing interventions targeting preschool-aged children thus requires awareness of the challenges that parents face [187]. In the ML study we offered child care during the group sessions to facilitate parent participation. However, this was still not enough for all families, especially not for families where mothers were on maternity leave or in school. Many families also requested for the groups to be held at different hours or weekdays. Due to the slow recruitment pace and to small resources (few group leaders) we were unable to adhere to these requests. Qualitative studies examining the acceptance and wishes of parents for optimal set-up for this age group may be one way to increase success in early interventions, especially in more socioeconomically challenged families [96].

Further, to improve the recruitment of families to obesity interventions in the preschool age we still have obstacles to tackle. One such obstacle is the view that children will “grow out

of' their obesity, shared by both parents and health care professionals. Although, all obese children do not become obese adults [34], we know that it is hard for families to succeed in improving weight status without professional help. As shown in Study V, even with treatment children did not improve BMI SDS after 3 or 6 months. Another obstacle for the recruitment of preschoolers to treatment (and prevention) interventions is the difficulty child health care nurses face when addressing the child's accelerating or high weight status [54, 188, 189]. To make parents aware of their child's overweight can be challenging and sensitive. Thus, training in communication skills to prevent misunderstandings is sought after by the child health care professionals [183, 188, 189]. Equally important, when the nurses in child health care address the child's obesity they need support when referring the patient further. In a Swedish study nurses did not always feel supported by the pediatric clinic where they had referred the child to for treatment [188]. In order to curb the obesity epidemic, cooperation between the different levels of the child health and medical care need to be improved [188]. The limitations in cooperation could also be a symptom for lack of treatment options to offer the families.

In summary, early interventions are highly meaningful although the research is still in its infancy. Further research is especially needed on treatment set-up for interventions to be successful.

5.3 WHAT ROLE DOES A PARENT-ONLY TREATMENT PROGRAM HAVE IN CHILDHOOD OBESITY?

In Study V, a novel parent-only treatment program for preschool obesity was compared to standard treatment in outpatient pediatric clinics in Stockholm County. The children in the parent-only group had a significantly larger decrease in BMI SDS, BMI and waist circumference after 3 and 6 months compared to no change in the standard treatment group. The results raise questions about what set up is most optimal for early obesity treatment. Below I continue the discussion about early interventions regarding possible mechanisms for treatment success.

The positive results on child weight status in the preschool age found in previous research are probably related to the greater influence of parents on behaviors such as eating and physical activity [134]. Thus, targeting parents as exclusive agents of change in parent-only treatments (children not participating in the intervention) are suggested [133, 134]. There are many positive aspects of a parent-only approach. When only addressing parents, the support and discussions regarding healthy eating and physical activity are facilitated; for example when discussing food labels and food content or when discussing recipes and healthier cooking. Indeed in a preventive intervention, Swedish child health care nurses pointed out the challenges of involving the child when promoting healthy habits [188]. Further, specific support in behavioral management components (e.g., positive involvement, limit setting practices and appropriate feeding practices) was suggested to be important mechanisms for treatment success in the preschool age [135, 185]. Such components also become easier to discuss when only the parents are present, as they are the target. Parent-only interventions may also be more cost-effective [150, 190, 191], especially when compared to interventions offering separate

groups for children [192]. However, the cost-effectiveness needs further investigation [191, 192]. Although many positive aspects of a parent-only approach can be found, the results from previous studies are limited [192]. So far, parent-only treatments, although promising, have not shown to be superior to similar treatments including the child [192]. Interventions during the preschool age are lacking and have thus not been extensively evaluated. Also, parent-only obesity treatments are probably not optimal for children older than 12 years [134, 191].

The parent-only approach of the ML study has been questioned; this often related to the child-centered perspective of the Swedish child health care system. The child-centered perspective is based on the well-intentioned assumption that in order to understand the disease and be able to raise questions, children should be involved in the treatment. However, for preschool-aged children with obesity, providing parents with tools to improve healthy habits in the family must also be seen as having the child's health in focus. The parent-only treatment in this young age group can also help clarify who has the responsibility for the child's health and empower parents to tackle this responsibility [193]. A further advantage is the possibility for parents to raise concerns that may be uncomfortable to raise when the child is present. For example, how obesity affects the child's self-esteem and how they can comfort their child when he/she has been bullied. Further, in treatment we can also guide parents in how to talk about the child's weight and healthy habits in an age-appropriate manner [151]. This would avoid negative weight talk by parents that has previously been reported to induce body image problems and contribute to further weight gain in childhood and in adulthood [194-196]. In ML we meet the children for measurements and explain what we will do during the visit and describe what we talk about during the parent program in an age-appropriate way.

The ML parent-only program offers skills training in evidence-based positive parenting practices [115, 117]. It was not within the scope of this thesis to evaluate the influence of these practices on treatment effect. However, participants in the parent-only program found the focus on positive parenting clearly helpful as parenting is applicable in all situations with the child. Positive parenting has previously been associated to a healthier BMI and weight development, eating and physical activity habits in children [175, 197-200]. However, the inconclusive results from obesity treatment programs call for further investigation in this area [121-124]. We need to know more about the effect of child age and whether other components should be addressed and how (e.g., advice regarding healthy eating and physical activity, sleep duration, stress regulation for parents), the duration of the intervention and follow-up [121-124].

To evaluate the acceptance of the parent-only program we collected evaluation forms and conducted interviews with the participating parents. Based on the high scores on the final evaluation forms, the parents found the program meaningful and appropriate. The interviews provided valuable insight on the most appreciated parts of the program and suggestions for improvements that were divided into five themes: *eye-opener* (i.e., the parents had learned new things), *reminder* (i.e., were reminded of things they were already doing well), *change* (i.e., changes the family had made regarding food, physical activity and parenting),

uncomfortable (i.e., new situations or components that were a bit awkward at first) and *suggestions for improvement* (e.g., shorten the program, increase group size for a better dynamic, to talk more about the psychosocial aspects of obesity and provide information to give to the preschool). The individual components of the parent-only program suited parents' differently. Specifically, many parents found the interactive role plays uncomfortable; however, they recognized the benefits of trying new skills before using them at home. To make parents comfortable in roleplay situations, the group leaders acted in the initial roleplay and then the parents were asked to try one of the roles. All parents agreed to the usefulness of meetings with other parents of children with obesity. Further, mirroring other qualitative evaluations [96, 183, 187], the practical and interactive presentation of content helped create new perspectives, which in turn encouraged parents to try new ways of handling challenging situations with the child. The practical and interactive components of obesity interventions are recommended [185].

In summary, parent-only treatments for obesity in the preschool age need further investigation. However, this treatment set-up has many advantages and was well accepted by parents participating in the ML study.

5.4 WHAT ASSOCIATIONS TO SOCIODEMOGRAPHIC FACTORS WERE FOUND?

Understanding the impact of sociodemographic factors is critical for tailoring obesity interventions to make them more effective.

In Study I, low parental education level was associated to a higher child weight status during infancy, independent of parental BMI. Although, parental weight is the strongest risk factor for later obesity [36] we could not find an association between high parental BMI and a higher child weight status at this early age. The results are supported by previous research showing that the genetic influence (parental weight status) on child weight status is lower at birth and grows stronger with age [41, 201]. Regarding the association with parental education level and child weight status, the mechanisms of SES on child weight development are not clear and differ between countries and within countries depending on age, gender, ethnicity/immigrant status, inequality rates and living area (higher rates of obesity in rural areas) [7, 8, 12, 13, 45]. Education level is one indicator of SES and a high education level is indeed becoming more important in gaining employment [13]. A higher education level may indicate more knowledge about healthy habits and a higher level of critical thinking may protect against conflicting and ungrounded messages in media [9, 13]. Income and occupational status, two other indicators of SES, although related, have instead been suggested to influence obesity through lack of economic resources [9, 13]. Lack of economic resources can make it more difficult to offer a variety of healthy foods, especially when prices on more energy dense foods are lower, and pay for leisure time activities [13]. Also, low SES families may be linked to lower social support (e.g., support from grandparents). Lack of support from close family or other adults can lead to increased stress levels and a lower sense of control [59]. This in turn may contribute to a less healthy lifestyle and higher weight status in children [7, 59, 202]. Preliminary

results from a subsample of the ML population suggest a link between perceived low social support and a higher degree of obesity [202].

In Study V there was a significant difference in treatment effect favoring children of mothers born in Sweden, and of mothers and fathers with the highest education level. The impact of sociodemographic factors on treatment results in preschoolers (and in other ages as well) is still poorly described in the literature [136]. An Italian study that tested MI as treatment of preschool obesity concluded MI to be counterproductive in families where mothers had a low educational level [203]. The results suggest that sociodemographic factors such as education level need to be accounted for in obesity interventions and that different support might be needed for families of different backgrounds. In Germany, children with an immigrant background were also reported to have a lower response to treatment [204]. The lack of reports on the impact of SES on treatment in preschoolers may be explained by the fact that many interventions fail to reach families of diverse ethnicity and those of low SES [7, 185]. A strength of the ML parent-only program is thus that we reached a wide range of families and that the effect on child weight status was seen even for families with low parental education level.

To conclude, sociodemographic factors need to be in focus in the context of childhood obesity. We need to know more about how different factors impact weight development, eating behavior, feeding practices and treatment effect. Sociodemographic factors should be considered when designing interventions so that information is delivered in a suitable and respectful way to families of different backgrounds [205].

5.5 HOW DOES CHILD EATING AFFECT PARENTS' FEEDING PRACTICES?

In Study III, associations between child eating behaviors and parenting feeding practices were examined. The findings were in accordance with previous research in the field with associations between a child's small appetite (Food avoidance) and parental Pressure to eat [106, 110, 206-209]. However, a small appetite does not necessarily mean that the child is eating too little thus; pressuring feeding practices may reflect parents' difficulties to assess appropriate portion size and recommended intake for preschoolers [73]. Parents may also not trust the child's own satiety cues and therefore use pressuring feeding practices. Thus, supporting parents in appropriate feeding practices to encourage internal hunger and satiety cues are important in all families, not just those with an overweight or obese child [210]. Further, a large appetite in the child was not associated to restrictive feeding practices as previously have been found [110]. Instead our model showed a mediating effect of Concern for the child being overweight on Restriction. Child BMI SDS was also correlated to parental Concern for the child being overweight. However, child BMI SDS did not directly affect restrictive feeding practices as seen previously [110]. Thus, it is not until the parents are worried about the child's weight that they use restrictive feeding practices. These findings are also supported by the literature [211, 212] and raise two concerns. First, a large appetite in the child may not lead to supportive feeding practices until the child has developed overweight or obesity. Secondly, recognizing your own child's weight status is difficult and more so if your child is overweight or obese [213]. Thus, even in an overweight or obese child parents may not change feeding practices unless they recognize the child's overweight and are concerned. Professionals addressing a child's accelerating weight in an appropriate way is important to be able to guide the parents in how to handle a large appetite [54]. An appropriate approach would be to encourage parents to avoid having unhealthy foods and drinks in the home and discuss appropriate meal times, rather than to be overly restrictive in feeding situations [214, 215].

Child BMI SDS was related to child eating behavior (positively for Food approach and negatively for Food avoidance). These associations are in accordance with many previous findings and suggest a role of appetitive traits in the development of obesity [93, 216, 217]. Interestingly, the genetic risk of becoming obese was not mediated by appetitive traits in 4 to 8-year-old Norwegian children [218]. Eating behavior should thus be incorporated as a part of obesity interventions and not the sole target.

In summary, child eating behavior and parental feeding practices should be addressed in the child health care setting to guide appropriate portion sizes and feeding practices.

5.6 METHODOLOGICAL CONSIDERATIONS

This thesis required many methodological considerations and compromises. Below, I discuss methodological limitations not previously addressed.

5.6.1 Study I

In Study I, the risk groups were created on the basis on parental education level and parental BMI. However, the families were not randomized to the risk groups and thus preexisting differences between the groups could not be accounted. Although significant efforts were made to include families with different backgrounds, we failed in that respect, especially regarding ethnicity. In part, this is related to the inclusion criterion that at least one parent needed to understand Swedish. Further, our sample of parents is not representative of low educational level and the general population; in Early STOPP, 41% of mothers and 48% of fathers reported low education levels as compared to 65-70% in the population [219]. Thus, the generalizability of our results to other populations should be made with caution. We relied on reported data from parents for weight and height at birth, 3 and 6 months age. However, these measures were made by experienced child health care nurses and thus we considered these measurements reliable to use.

5.6.2 Study II and III

5.6.2.1 Validity and reliability of the LBC and the CEBQ

In Study II and III, we wanted to test the validity and internal reliability of the LBC and the CEBQ. The validity of an instrument/questionnaire is considered to be the degree to which the tool measures what it claims to measure [154]. Thus, with valid instruments we can draw accurate conclusions about our data [154]. Before using an instrument in a population, its validity for that population needs to be tested and possibly adapted using appropriate methods. Thus, below I describe how we accounted for the younger age of the children in our sample compared to previous populations where LBC was used [162, 220] and cultural adaptations (both LBC and CEBQ) to improve the validity of the instrument. CFA should be used for previously validated questionnaires when a hypothesis of factor structure already exists. For the LBC, no prior study had used CFA [162, 220]. The CEBQ, in spite of being a more widely used instrument in variety of diverse populations, [94, 221-228] had only been examined with CFA once before in an Australian study [225]. To test the LBC and CEBQ in the population we later intend to study (parents of preschoolers with overweight and obesity), we contacted preschools and schools from different parts of Stockholm County. Through the schools we expected to obtain a diverse sample regarding child and parental weight status and parental education level and ethnicity. However, the final school sample included more parents born in Sweden with a higher educational level and a lower weight status than the general population. To increase heterogeneity, and thus to be able to compare differences in the reports of parents based on child weight status, we included a clinical sample in the analysis. Indeed, the clinical sample of parents contributed to increased heterogeneity for child weight status as well as to education level and ethnicity/foreign background.

When the LBC was initially tested using CFA in our population, we found a poor fit to the data. This was in accordance with what we had expected, as the younger age of our population would influence the appropriateness of several questions. Instead, a modified 5-

factor structure proved best fit to the data, introducing a new factor: Screen time. The original factor, Physical activity (measuring problem behaviors regarding physical inactivity), was thus split into two factors to improve specificity of the studied variables in our population. In the preschool age group, physical inactivity (e.g., the child does not want to play) is typically less problematic [229]. Parents often find that their preschool-aged children are active [230, 231]. However, excessive screen time is being increasingly reported during this period [232, 233]. Our results support both findings; mothers were less likely to report problem behaviors regarding physical inactivity and child age was positively associated with screen time behavior. Thus, having two different factors, one for physical inactivity and one for screen time behaviors seem appropriate. Further, parents reported lower levels of screen time behavior in girls. This finding is also supported by previous research. Girls in this age group engage in other types of activities instead such as drawing and doing crafts [233]. Other modifications made to improve the fit to the data were the exclusion of some items. The items that were identified as not suitable for this younger sample concerned if the child: *hides food*, *complains about not having enough friends* and *complains about not being attractive*. Further items that we excluded to improve fit to the data were: *whines or whines about food* (was ambiguous and thus difficult to understand), *refuses to eat certain food* (i.e. fussy eating; did not load on the expected factor) and *eats unhealthy snacks*. In the cognitive interviews for the LBC, snacking was difficult for parents to identify. A snack meal was regarded as a structured planned meal rather than something eaten more spontaneously. This could explain why this item had to be excluded. All the above mentioned items had been recognized as problematic to understand during the cognitive interviews performed with a subsample of parents. The LBC is an Australian questionnaire, thus; we made some cultural adaptations such as softening the language (e.g., takes instead of steals food) to make the items more appropriate for the Swedish context. The Confidence scale of the LBC proved to be unidimensional, meaning that the self-efficacy of parents was not specific to the different behaviors measured but seem to be a more global construct (e.g., if the parent reported high confidence in handling food related behaviors, confidence was also high for handling screen time and physical activity related behaviors). Further, the Confidence scale was not significantly associated to any child or parental characteristics, suggesting that confidence is associated to other factors than those examined. The results suggest, in accordance to previous findings [232], that increasing parental confidence during the preschool age may be of importance for improving the child's lifestyle and possibly influencing child weight status. To further test the validity of the questionnaire, we assessed associations between the LBC and the CFQ. Parents who scored high on the LBC factors also reported being more restrictive of their child's eating as well as more concerned with the child's weight. All these associations are logical and supported our hypotheses that the LBC does measure obesity-related behavior in children. Additionally, parental monitoring of the child's eating was correlated to low scores for Screen time. This association is also relevant, as monitoring has been suggested as a parenting practice that promotes a healthy lifestyle for children [113, 234, 235].

In summary, the LBC and CEBQ are valid instruments to use in a Swedish population of parents of preschoolers. The relatively small adjustments made to the instruments suggest that they work cross-culturally, implying that child behaviors and parenting are universal or at least perceived as such. Validating questionnaires in different populations will facilitate their use by researchers and clinicians. Increased use and evaluation of results will enable us to compare behaviors between populations of different ages, genders, ethnic backgrounds and parental education levels. This increased knowledge will further help in the design of interventions aiming to prevent and treat obesity.

5.6.2.2 Other methodological considerations

Self-reporting data regarding eating behaviors and feeding practices introduce participants' biases. Previous studies have reported differences in reported feeding practices and observed feeding practices (i.e., reported restriction was higher than observed) [236, 237]. It is possible that the laboratory setting, which is very different from the home environment, and observational studies in general, may not be able to capture all dimensions of restrictive feeding such as covert feeding practices (e.g., limiting unhealthy foods in the home environment) [214]. Awareness of the discrepancies between reported and observed behaviors is important since self-reported data is the most practical way to assess behaviors in large studies. To improve the quality of reported data, testing the psychometric properties of instruments is vital. Through this process we learn how questions are understood and misunderstood, thus helping us to interpret data.

A further limitation in the validation studies are child- and parent-reported weight and height. Measured data would have strengthened the results. However, for a majority of the children, these measures had been taken by the child health care or school nurse (82%). Questionable measures were excluded from the analysis (BMI corresponding to underweight, n = 18). The cross-sectional nature of the data in Study II and III does not allow us to draw conclusions about causality between child behaviors and parenting practices. However, with the two measures now validated in a Swedish preschool population, we have enabled longitudinal research in the field.

5.6.3 Study V

The ML study is a large RCT with preschoolers with obesity, including a heterogeneous sample of families regarding parental education level and foreign background. Although our sample is diverse, we only included families who were able to communicate in Swedish so that the parents would be able to attend treatment held in Swedish. Therefore, the generalizability of the results to families requiring an interpreter for treatment is a consideration. We considered using interpreters for the group treatment due to the higher prevalence of obesity in children with parents of a foreign background. However, we were advised against it by experienced professionals due to the risk of negatively affecting the group dynamics (e.g., parents not being able to understand the language may not feel supported in the group setting). Instead, a possibility for future implementations would be to

offer the program in different languages. This was previously tested successfully with the KEEP program across varied geographic settings [115, 116, 238].

The measured anthropometrics of the children is a strength of the study. However, it should be noted that to be able to describe the whole population at baseline, we used data collected at inclusion in the study for a small proportion of children: 6 children in the parent group (7%) and for 13 of the children in the standard treatment group (15%). Considerable effort was made to increase the number of questionnaires returned for the parent-only group: 69% (children), 66% (mothers) and 63% (fathers) and standard treatment: 80% (children and mothers), 70% (fathers). It is possible that a different approach for collecting questionnaires (i.e., face to face) would have improved the completion rate. Although we did meet some families face-to-face when collecting the questionnaires, we did not have the resources to meet with all families.

The ML parent-only program was compared to standard treatment offered in outpatient pediatric clinics. For the majority of families, the standard treatment was individual visits that included the child; only six families had attended group treatment. The non-treated control group may be seen as a limitation to the study. However, having an untreated control group was not considered ethically viable (i.e., to withhold an existing treatment to children). It is possible that a more similar control group with the same initial intensive design would have resulted in a smaller difference in treatment effect between conditions such as a parent-group with or without parenting practices. A previous study with older children tested the relevance of positive parenting practices. Although a larger reduction for the group receiving positive parenting training was found, the difference was not significantly or clinically relevant [121]. It is also possible that a similar control group including both parents and children would have shown the same results, which is supported in the literature [133]. However, with the present

design we have shown a significantly larger change in the primary outcome, and more importantly, a clinically relevant decrease in BMI SDS for children whose parents were offered a parent-only program. Also, the standard treatment currently offered to families with preschoolers in Stockholm County did not show any improvements in child BMI SDS, BMI or waist circumference after 3 and 6 months.

A further limitation to Study V is the possible bias introduced by the researchers being involved in all processes of the study. Although, blinded measurements and a more objective design would have been preferred, this was not possible due to resources. The high-level of clinical training in obesity of the parent-only program group leaders could also question the effects the program will have if implemented in the usual care setting [185]. A high-level of clinical training in obesity is already present in some but not all pediatric outpatient clinics and perhaps those individuals are most suited to be further trained in the ML program. However, the thorough training in the manual-based program is a strength that will ease the implementation and education of personnel with less experience. The initial training includes both theory and practice and is then followed by supervision; these elements will enable feasibility of the program and facilitate implementation [239].

A further limitation to Study V is the high attrition rate, a common concern in most obesity interventions [185]. In a study using a similar parent-only program the attrition rate was 35% [122]. The rate of attrition in our parent-only group was 32% compared to 13% for standard treatment. Attrition in obesity interventions has previously been associated to low socio-economic status, single-parent families and parents of foreign background [185, 240]. The only difference between participants in the parent-only program and those who were lost to follow-up in our sample was the mother's occupational status. Higher attrition rates were seen if mothers were on maternity leave or in school. These are logical reasons for why participating in a weekly scheduled group meeting may be difficult. The high attrition may also indicate that a parent group program is not suitable for all families. Thus, different types of obesity programs are probably needed to optimize treatment effect and reduce drop out. Due to the high attrition rate, missing follow-up values and missing values on baseline covariates were imputed simultaneously using multiple imputation with chained equations. The number of imputations was set to 10, thus, deriving 10 predicted values. Multiple imputation is one of the recommended methods for handling missing data, ensuring efficiency (compared to complete case analysis) while still taking uncertainty into account (which single imputation or last observation carried forward does not) [241, 242].

Process evaluation

The qualitative and quantitative analyses of the parent-only program strengthen the study. Acceptance and suitability of treatment interventions are seldom reported although vital in order to develop optimal programs suitable to the intended population [76]. Regarding the interviews that were conducted post intervention there are some aspects to consider. There was a variation in the attendance rate of parents being interviewed (42% -100%). We did not interview those parents who dropped out of the group. However, our aim was to evaluate

acceptance and suitability of program content and questions regarding program content would have been difficult to answer for those who had not attended the program. The process evaluation has allowed us to improve the program content continuously. For example, during the interviews parents addressed the importance of having large enough groups for better discussions. These comments made us delay the group start and over-recruit participants in order to have a large enough group. We also shortened the program by two sessions based on parent interviews; however, the program content remained the same.

It was important to us that no harm had been inflicted on the parents or the children by being part of an obesity intervention. On the contrary parents, felt more competent and confident in handling difficult situations.

5.7 CLINICAL IMPLICATIONS

This thesis supports the idea that early preventive obesity interventions should be targeted to risk groups, especially families of low socioeconomic status. However, children of overweight and obese parents are also at risk for obesity and should thus also be targeted in interventions.

It is a priority to increase the knowledge gap regarding what child obesity-related behaviors parents find difficult to handle. Thus, the use of appropriate instruments in interventions for overweight and obesity to identify such a gap should be encouraged. Parents' perception of their own feeding behavior and their child's eating behavior can help guide professionals to know what challenges to address to support families in need of improved lifestyle changes.

Future obesity prevention and treatment interventions should test the interplay between child eating behaviors and parenting practices and develop recommendations for clinical practice.

The ML parent-only program presented in this thesis has proved to be successful in decreasing child weight status and is well accepted by parents. Because the ML study was developed and conducted in close collaboration with the child health care providers in Stockholm County, such a design will facilitate future implementation of the program.

The positive parenting techniques taught in the program are useful for all families. Thus, child health care professionals trained in the ML program could therefore use their knowledge to help families other than those of children with obesity, justifying the cost of program implementation.

5.8 FUTURE STUDIES

- Further understanding regarding early risk factors for childhood obesity is needed as well as the ability to target these risk factors in interventions.
- A better understanding of sociodemographic factors associated with obesity may improve recruitment of more diverse populations and thus reach more vulnerable populations.

- The links between child eating behavior and other obesity related behaviors such as screen time behaviors, effective and ineffective parenting practices and effects on weight status thorughout childhood should be examined in prospective studies.
- Future ML studies will examine the mechanisms behind our results on weight status. Specifically, we will examine the influence of general and feeding-related parenting practices, parental self-efficacy, child eating behavior, child and parent psychosocial health and food and physical activity. A thorough evaluation of ML will strengthen the evidence and thereby impact the design of future treatment programs for preschool obesity.

6 CONCLUSIONS

This thesis has shown that:

- Low parental education level, but not parental BMI, was associated with higher child BMI SDS during the first year of life. No significant associations were seen for rapid weight gain and parental education and BMI. Previously known early life risk factors could not explain the associations.
- Obesity-related problematic behaviors are associated to weight in preschoolers. Higher scores of problematic behaviors correlated to lower scores in parental confidence in handling these behaviors.
- Parents of children with small appetites reported higher levels of pressure to eat. The relationship between children with large appetites and restrictive feeding practices was mediated by concern for the child being overweight.
- A parent-only treatment program for preschool obesity outperformed standard treatment. Improvements were seen for BMI SDS, BMI and waist circumference for the parent-only group while no decrease was seen for any outcome for standard treatment.
- The children in the parent-only group were more than three times more likely to have a clinically significant decrease in BMI SDS after 3 months, and more than four times more likely after 6 months. Further, the parent group children were also twice as likely to maintain any reduction in BMI SDS from 3 to 6 months follow up.
- Children with parents with a university degree and children with mothers of Swedish background responded better to the parent-only treatment. However, children to mothers of low education level in the parent-only treatment group also had a significantly larger improvement in weight status than children offered standard treatment.
- The parent-only treatment showed that feasibility, acceptance and relevance of the program components were very high.

7 OWN CONTRIBUTIONS IN THE STUDIES

Study I. Designed the study and formed the scientific question together with VS in discussion with the supervisors, conducted the descriptive analysis and logistic regression and created the tables, wrote the introduction together with VS and was the main writer of the methods section. VS was the main writer of the results and the discussion and AE was responsible for the correspondence with journals.

Study II. Designed and performed the study with support from the supervisors and the co-authors, wrote the ethics committee application, conducted the cognitive interviews, was involved in recruitment and data collection, created the database and instructed students who entered data, conducted the descriptive data analyses and the exploratory factor analysis, conducted the literature search and wrote the manuscript under supervision.

Study III. Designed and performed the study with support from the supervisors and co-authors, wrote the ethics committee application, was involved in recruitment and data collection, created the database and instructed students who entering data and conducted the descriptive data analyses. AE and KE conducted the literature search, wrote the manuscript under supervision and with support from the supervisors and the other co-authors.

Study IV. Was involved in the design of the study, was involved in writing the ethics committee application, wrote the supplementary applications, was involved in all parts of the ML study, conducted the literature search and drafted the manuscript under supervision.

Study V. Formed the aims and hypotheses in discussions with the supervisors and the co-authors, contributed to the study design, was involved in the recruitment of patients and treatment sessions, in collection and entry of data, set up the database for this study, conducted the descriptive statistical analyses and the mixed model analyses with support from KS, conducted the literature search and drafted the manuscript under supervision.

8 RELATED ARTICLES NOT INCLUDED IN THE THESIS

Obesogenic dietary intake in families with 1-year-old infants at high and low obesity risk based on parental weight status: baseline data from a longitudinal intervention (Early STOPP).V. Svensson, T. Sobko, A. Ek, M. Forssén, K. Ekbom, E. Johansson, P. Nowicka, M. Westerståhl, U Riserus, C Marcus. *Euro J Nutr, 2015. 55(2):781-92*

Low grandparental social support combined with low parental socioeconomic status is closely associated with obesity in preschool-aged children: A pilot study. L. Lindberg, A. Ek, J. Nyman, C. Marcus, S. Ulijaszek, P. Nowicka. *Pediatr Obes, 2016. 11(4):313-6.*

Objectively measured physical activity in two-year-old children – levels, patterns and correlates. E. Johansson, M. Hagströmer, V. Svensson, A. Ek, M. Forssén, H. Nero, C. Marcus. *Int J Behav Nutr Phys Act. 2015. 24;12:3.*

A randomised controlled trial for overweight and obese parents to prevent childhood obesity - Early STOPP (STockholm Obesity Preventive Program). T. Sobko, V. Svensson, A. Ek, M. Ekstedt, H. Karlsson, E. Johansson, Y. Cao, M. Hagströmer, C. Marcus. *BMC Public Health. 2011. 18;11:336.*

9 ACKNOWLEDGEMENTS

I would like to express my warmest gratitude to all of you who have supported and guided me through my doctoral studies.

Paulina Nowicka – my principal supervisor. Thank you for all your support through these years and for believing in me even when I doubted myself, it has meant more to me than you will ever know. Without you I would not be where I am today. With tremendous scientific curiosity, broad knowledge and courage you are a true inspiration. Thank you for all the fun times we have had during these years, and before. I look forward to many more to come. I was lucky that our roads crossed all those years ago in Malmö giving me a friend for life.

Claude Marcus – my co-supervisor. Thank you for giving me the opportunity to work with obesity research. Your broad knowledge in the field is impressive and inspiring and so is your visionary mind. Your support has meant a lot to me during these years.

Patricia Chamberlain – my co-supervisor. Thank you for giving me the opportunity to work with the KEEP program together with your team at OSLC. Our collaboration has been extremely rewarding and I feel so lucky to have had this chance. You are a fantastic role model and an inspiration in many ways.

Philip Fisher – my co-supervisor. Thank you for sharing your excellent and impressive knowledge in research. It has been a true privilege to have you on board during these years.

Gun Drott-Englén – for your encouraging and wise mentorship during these years.

Katie Lewis Chamberlain – for being a wonderful person, a friend and a fantastic supervisor in the KEEP program. Thank you for your many hours of hard work to improve the language in my manuscripts and in this thesis summary. The way you always find time to help is impressive. I look forward to future visits to Eugene and to see you back here in Sweden.

Viktoria Svensson – for being a great mentor when writing our manuscript together. Your research skills and knowledge are impressive. You were also a great support in the early days of the Early STOPP. Thank you for your valuable comments during the writing of this thesis. Above all, thank you for being such a good friend.

Kimmo Sorjonen – for your statistical expertise and contributions in my papers. For your enormous patience in explaining statistics to me. I don't know what I would have done without you.

Karin Eli – for being a great co-author and sharing your writing skills during these years.

Jonna Nyman – for your hard work in recruiting and measuring children in the ML study, for being so flexible and for being an excellent co-leader and colleague.

Louise Lindberg – for your hard work in the ML study especially in recruiting children for your great efforts in collecting questionnaires, for being in control at times when I haven't been. Thank you for your valuable support in writing this thesis and for being a great colleague.

Mahnoush Etminan Malek – for being a great colleague and friend and a brilliant co-leader of the ML program. Thank you for always wanting to help and for always being so positive and supportive.

Sofia Ljung – for your impressive work in the early days of the ML study and for being a great co-leader and colleague.

Karin Nordin – for being an excellent nurse and for being so helpful and supportive in collecting data for the ML study. I look forward to working more closely with you, you are a great colleague.

JP Davis – for providing excellent training in the KEEP program during our Eugene visit and for being so encouraging.

Michaela Forssén – for your hard work in Early STOPP, for being a fantastic nurse taking such good care of all the families. I am so glad to have had the opportunity to work with you.

Elin Johansson – for all our work together with the Early STOPP study and for being a close PhD friend.

Sofia Trygg-Lycke – for being an excellent coach in motivational interviewing and being so supportive in both the Early STOPP and the ML study.

Pernilla Hedvall-Kellerman – for your helpful comments on my thesis and for being a great colleague and friend.

Emilia Hagman – for being so helpful in practical matters regarding my dissertation and for your valuable layout tips for the thesis.

Lisbeth Sjödin and **Maria Staiger** – for your support and excellent work in all administrative matters and for being so helpful.

Other current and former Early STOPP co-workers – **Anja Nordenfeldt, Håkan Nero, Julia Xiu, Kerstin Ekbom, Linnea Bergqvist, Lisa-Marie Larisch, Margit Wrba, Maria Hagströmer, Mirjam Ekstedt, Manjula Fisher, Mojgan Ebrahim, Yingting Cao** and **Ylva Beckman** – for the hard work and fun times together.

Ulf Hammar – for your statistical expertise and for responding to all my questions in a pedagogic way.

Jan Kowalski – for statistical support in Study I and in the beginning of the ML study.

Other current and former members of the research group at B62 – **Anna E Ek, Azziz Elgadi, Eva Flygare-Wallén, Eva Wallén-Nielsen, Gisela Nyberg, Gustav Olsson, Helen Zemack, Maria Westerståhl, Markus Brissman, Mikaela Persson, Veroniqa Lundbäck, Pernilla Danielsson-Liljeqvist, Veroniqa Lundbäck** and **Örjan Ekblom** – thank you for being such great colleagues, making it fun and inspiring to go to work.

Other current and former members of the ML steering group – **Jan Ejderhamn, Lena Frenzel, Ola Eklund, Nilüfer Kayihan Kuru, Ann-Charlott Lindfors, Marie Johannesson** and **Giselle Hedberg** – without you we would not have been able to start the ML study. Thank you for always being very supportive and trying to find solutions for how to best recruit families to the ML study. **Lena**, thank you for arranging the use of the Child health care's premises for our parent groups and for always being so helpful and positive towards our work. **Jan** and **Ola**, thank you for your input in how to best organize the flow of patients from the ML study to the pediatric clinics and for always being very supportive. I would also like to send my gratitude to **Margareta Blennow**, Senior physician at the Child health care unit in Stockholm County, who was very helpful and supportive in the early days of the ML study.

Other current and former members at Barnöverviktsenheten Region Skåne i Malmö – **Annica Larsson, Ami Stenberg, Björn Hedqvist, Carl-Erik Flodmark, Jet Derwig, Kajsa Järvholm, Kathy Falkenstein-Hagander, Katrine Möller Voss, Lena Schultz, Maria Hällvik, Marianne Persson, Susanne Bach Meineche, Torsten Olsson, Ulla Folin** and **Ulla Börjeson-Munk** – for being such great colleagues teaching me a lot about childhood obesity and treatment skills. Thank you for all fun times together.

Current and former members at Rikscentrum för Barnobesitas – for always being so supportive of my work and for sharing your premises to us for the ML parent groups.

To all child health care nurses in Stockholm County – for your help in recruiting families to the Early STOPP and to the ML study. For sharing your experiences on my visits and for letting us use your premises when measuring the ML children.

To all personnel in the pediatric clinics in Stockholm County – for your help in recruiting families and for our excellent collaboration regarding the families participating in the ML study.

To all school nurses and pediatricians in Stockholm County – for your help in recruiting families to the ML study.

To all schools and preschools involved in the validation study – for your support in organizing the distribution and collection of questionnaires.

All families in the Early STOPP – thank you for making the study possible. To "my" families, thank you for letting me be a part of your life during these years.

All parents participating in the validation study – thank you for taking the time to complete the questionnaires and sending them in to us.

All families in the ML study – thank you for making the study possible. To all families that have participated in the parent program during the years, thank you for sharing your experience, knowledge and concerns with us. The experiences as group leader have been very rewarding, all due to you.

I am lucky to have many fantastic **friends** and **relatives**. Thank you all for being so great, for offering help and support and for all fun times together.

Anna and **Anders** – for helping me with the practicalities of the celebration of this thesis and for all fun times and travels together.

Agneta André – my mother-in-law and **Per André** – my father-in-law, thank you for being interested in my work and for helping us with Alice and Melker during these years making it possible for me to be flexible in my work.

Birgitta and **Willy Ek** – my wonderful parents, I don't know how we would have survived these years without your help. Thank you for always believing in me and for being the best supporters and thank you for always finding the time for Alice and Melker.

Lena and **Fredrik** – my sister and brother, thank you for being supportive and for all the fun times together. I am so proud of you.

Staffan – my life partner, soulmate and best friend. Thank you for all your support during these years and especially during this summer. We are a great team and I love you!

Melker och **Alice** – mina älskade barn. Ni är det viktigaste som finns och jag är så stolt över er och över att få vara er mamma. Ni påminner mig varje dag om vad som är viktigast här i livet. Jag älskar er!

Financial support for the studies in this thesis was gratefully received from: Foundation Frimurare Barnhuset in Stockholm, Foundation Martin Rind, Foundation Pediatric Care, Fredrik and Ingrid Thurings Foundation, Helge Ax:son Johnsson Foundation, HRH Crown Princess Lovisa's Foundation for Pediatric Care, ìShizu Matsumuraîs Donation, Jane and Dan Olsson's Foundation, the Jerring Foundation, Karolinska Institutet Doctoral Funds, Magnus Bergvall Foundation, National Institute on Drug Abuse, the Division of Epidemiology Services and Prevention Research, U.S., Nestlé Healthy Kids Programme, Samariten Foundation, Sigurd and Elsa Golje Memory Foundation, the Sweden-America Foundation, the Swedish Council for Working Life and Social Research, the Swedish Heart-Lung Foundation, the Swedish Research Council for Medical Research, Swedish Society of Medicine, Vinnova, and the Åke Wiberg's Foundation.

10 REFERENCES

1. WHO. World Health Organization2016 [cited 20 July 2016]. http://apps.who.int/bmi/index.jsp?introPage=intro_3.html].
2. Forsum E, Flinke Carlsson E, Henriksson H, Henriksson P, Lof M. Total body fat content versus BMI in 4-year-old healthy Swedish children. *J Obes*. 2013;2013:206715.
3. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*. 2000;320(7244):1240-3.
4. Cole TJ, Flegal KM, Nicholls D, Jackson AA. Body mass index cut offs to define thinness in children and adolescents: international survey. *BMJ*. 2007;335(7612):194.
5. Karlberg J, Luo ZC, Albertsson-Wikland K. Body mass index reference values (mean and SD) for Swedish children. *Acta Paediatr*. 2001;90(12):1427-34.
6. Ng M, Fleming T, Robinson M, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*. 2014;384(9945):766-81.
7. Ulijaszek SJ, Pentecost M, Marcus C, Karpe F, Fruhbeck G, Nowicka P. Inequality and childhood overweight and obesity: a commentary. *Pediatr Obes*. 2016.
8. Wang Y, Lim H. The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. *Int Rev Psychiatry*. 2012;24(3):176-88.
9. Bouthoorn SH, Wijtzes AI, Jaddoe VW, Hofman A, Raat H, van Lenthe FJ. Development of socioeconomic inequalities in obesity among dutch pre-school and school-aged children. *Obesity (Silver Spring)*. 2014.
10. Moraeus L, Lissner L, Yngve A, Poortvliet E, Al-Ansari U, Sjoberg A. Multi-level influences on childhood obesity in Sweden: societal factors, parental determinants and child's lifestyle. *Int J Obes (Lond)*. 2012;36(7):969-76.
11. Bammann K, Gwozdz W, Lanfer A, et al. Socioeconomic factors and childhood overweight in Europe: results from the multi-centre IDEFICS study. *Pediatr Obes*. 2013;8(1):1-12.
12. Khanolkar AR, Sovio U, Bartlett JW, Wallby T, Koupil I. Socioeconomic and early-life factors and risk of being overweight or obese in children of Swedish- and foreign-born parents. *Pediatr Res*. 2013;74(3):356-63.
13. Magnusson M, Sorensen TI, Olafsdottir S, et al. Social Inequalities in Obesity Persist in the Nordic Region Despite Its Relative Affluence and Equity. *Curr Obes Rep*. 2014;3:1-15.
14. Moraeus L, Lissner L, Sjoberg A. Stable prevalence of obesity in Swedish schoolchildren from 2008 to 2013 but widening socio-economic gap in girls. *Acta Paediatr*. 2014;103(12):1277-84.
15. Primary Child Health Care Report 2013. Mottala: Stockholm County Sweden, Barnhälsovården i Stockholms län. 2013.
16. de Munter J, Friedl A, Lind S, et al. Stability in the prevalence of Swedish children who were overweight or obese in 2003 and 2011. *Acta Paediatr*. 2016.
17. Farpour-Lambert NJ, Baker JL, Hassapidou M, et al. Childhood Obesity Is a Chronic Disease Demanding Specific Health Care--a Position Statement from the Childhood Obesity Task Force (COTF) of the European Association for the Study of Obesity (EASO). *Obes Facts*. 2015;8(5):342-9.
18. Franks PW, Hanson RL, Knowler WC, Sievers ML, Bennett PH, Looker HC. Childhood obesity, other cardiovascular risk factors, and premature death. *N Engl J Med*. 2010;362(6):485-93.
19. Myers MD, Raynor HA, Epstein LH. Predictors of child psychological changes during family-based treatment for obesity. *Arch Pediatr Adolesc Med*. 1998;152(9):855-61.
20. Lobstein T, Jackson-Leach R, Moodie ML, et al. Child and adolescent obesity: part of a bigger picture. *Lancet*. 2015;385(9986):2510-20.
21. Hayes A, Chevalier A, D'Souza M, Baur L, Wen LM, Simpson J. Early childhood obesity: Association with healthcare expenditure in Australia. *Obesity (Silver Spring)*. 2016.
22. Juonala M, Magnussen CG, Berenson GS, et al. Childhood adiposity, adult adiposity, and cardiovascular risk factors. *N Engl J Med*. 2011;365(20):1876-85.
23. Gardner DS, Hosking J, Metcalf BS, Jeffery AN, Voss LD, Wilkin TJ. Contribution of early weight gain to childhood overweight and metabolic health: a longitudinal study (EarlyBird 36). *Pediatrics*. 2009;123(1):e67-73.
24. Nappo A, Iacoviello L, Fraterman A, et al. High-sensitivity C-reactive protein is a predictive factor of adiposity in children: results of the identification and prevention of dietary- and lifestyle-induced health effects in children and infants (IDEFICS) study. *J Am Heart Assoc*. 2013;2(3):e000101.
25. Reinehr T, Wolters B, Knop C, Lass N, Holl RW. Strong effect of pubertal status on metabolic health in obese children: a longitudinal study. *J Clin Endocrinol Metab*. 2015;100(1):301-8.
26. Ackard DM, Neumark-Sztainer D, Story M, Perry C. Overeating among adolescents: prevalence and associations with weight-related characteristics and psychological health. *Pediatrics*. 2003;111(1):67-74.
27. Wardle J, Cooke L. The impact of obesity on psychological well-being. *Best Pract Res Clin Endocrinol Metab*. 2005;19(3):421-40.
28. Schwimmer JB, Burwinkle TM, Varni JW. Health-related quality of life of severely obese children and adolescents. *JAMA*. 2003;289(14):1813-9.

29. Puhl RM, Latner JD. Stigma, obesity, and the health of the nation's children. *Psychol Bull*. 2007;4(133):557-80.
30. Wardle J, Volz C, Golding C. Social variation in attitudes to obesity in children. *Int J Obes Relat Metab Disord*. 1995;19(8):562-9.
31. Latner JD, Stunkard AJ. Getting worse: the stigmatization of obese children. *Obes Res*. 2003;11(3):452-6.
32. Puhl R, Brownell KD. Bias, discrimination, and obesity. *Obes Res*. 2001;9(12):788-805.
33. Baranowski T, Lytle L. Should the IDEFICS outcomes have been expected? *Obes Rev*. 2015;16 Suppl 2:162-72.
34. Simmonds M, Llewellyn A, Owen CG, Woolacott N. Predicting adult obesity from childhood obesity: a systematic review and meta-analysis. *Obes Rev*. 2015.
35. Taylor JH, Xu Y, Li F, et al. Psychosocial predictors and moderators of weight management programme outcomes in ethnically diverse obese youth. *Pediatr Obes*. 2016.
36. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med*. 1997;337(13):869-73.
37. Whitaker KL, Jarvis MJ, Beeken RJ, Boniface D, Wardle J. Comparing maternal and paternal intergenerational transmission of obesity risk in a large population-based sample. *Am J Clin Nutr*. 2010;91(6):1560-7.
38. Durmus B, Arends LR, Ay L, et al. Parental anthropometrics, early growth and the risk of overweight in pre-school children: the Generation R Study. *Pediatr Obes*. 2013;8(5):339-50.
39. Stunkard AJ, Harris JR, Pedersen NL, McClearn GE. The body-mass index of twins who have been reared apart. *N Engl J Med*. 1990;322(21):1483-7.
40. Silventoinen K, Jelenkovic A, Sund R, et al. Genetic and environmental effects on body mass index from infancy to the onset of adulthood: an individual-based pooled analysis of 45 twin cohorts participating in the COllaborative project of Development of Anthropometrical measures in Twins (CODATwins) study. *Am J Clin Nutr*. 2016.
41. Dubois L, Ohm Kyvik K, Girard M, et al. Genetic and environmental contributions to weight, height, and BMI from birth to 19 years of age: an international study of over 12,000 twin pairs. *PLoS One*. 2012;7(2):e30153.
42. Locke AE, Kahali B, Berndt SI, et al. Genetic studies of body mass index yield new insights for obesity biology. *Nature*. 2015;518(7538):197-206.
43. McLaren L. Socioeconomic status and obesity. *Epidemiol Rev*. 2007;29:29-48.
44. Shrewsbury V, Wardle J. Socioeconomic status and adiposity in childhood: a systematic review of cross-sectional studies 1990-2005. *Obesity (Silver Spring)*. 2008;16(2):275-84.
45. Besharat Pour M, Bergstrom A, Bottai M, et al. Effect of parental migration background on childhood nutrition, physical activity, and body mass index. *J Obes*. 2014;2014:406529.
46. Sobal J, Stunkard AJ. Socioeconomic status and obesity: a review of the literature. *Psychol Bull*. 1989;105(2):260-75.
47. Lissner L, Wijnhoven TM, Mehlig K, et al. Socioeconomic inequalities in childhood overweight: heterogeneity across five countries in the WHO European Childhood Obesity Surveillance Initiative (COSI-2008). *Int J Obes (Lond)*. 2016;40(5):796-802.
48. Semmler C, Ashcroft J, van Jaarsveld CH, Carnell S, Wardle J. Development of overweight in children in relation to parental weight and socioeconomic status. *Obesity (Silver Spring)*. 2009;17(4):814-20.
49. Howe LD, Tilling K, Galobardes B, Smith GD, Ness AR, Lawlor DA. Socioeconomic disparities in trajectories of adiposity across childhood. *Int J Pediatr Obes*. 2011;6(2-2):e144-53.
50. Sobal J. Obesity and socioeconomic status: a framework for examining relationships between physical and social variables. *Med Anthropol*. 1991;13(3):231-47.
51. Ulijaszek SJ. Socio-economic status, forms of capital and obesity. *J Gastrointest Cancer*. 2012;43(1):3-7.
52. Magnusson MB, Sjoberg A, Kjellgren KI, Lissner L. Childhood obesity and prevention in different socio-economic contexts. *Prev Med*. 2011;53(6):402-7.
53. Taveras EM, Gillman MW, Kleinman K, Rich-Edwards JW, Rifas-Shiman SL. Racial/ethnic differences in early-life risk factors for childhood obesity. *Pediatrics*. 2010;125(4):686-95.
54. Regber S, Marild S, Johansson Hanse J. Barriers to and facilitators of nurse-parent interaction intended to promote healthy weight gain and prevent childhood obesity at Swedish child health centers. *BMC Nurs*. 2013;12(1):27.
55. Benton D. Role of parents in the determination of the food preferences of children and the development of obesity. *Int J Obes Relat Metab Disord*. 2004;28(7):858-69.
56. El-Behadli AF, Sharp C, Hughes SO, Obasi EM, Nicklas TA. Maternal depression, stress and feeding styles: towards a framework for theory and research in child obesity. *Br J Nutr*. 2015;113 Suppl:S55-71.
57. Lampard AM, Franckle RL, Davison KK. Maternal depression and childhood obesity: a systematic review. *Prev Med*. 2014;59:60-7.
58. Shankardass K, McConnell R, Jerrett M, et al. Parental stress increases body mass index trajectory in pre-adolescents. *Pediatr Obes*. 2014;9(6):435-42.

59. Eli K, Sorjonen K, Mokoena L, et al. Associations between maternal sense of coherence and controlling feeding practices: The importance of resilience and support in families of preschoolers. *Appetite*. 2016;105:134-43.
60. Timmermans SH, Mommers M, Gubbels JS, et al. Maternal smoking during pregnancy and childhood overweight and fat distribution: the KOALA Birth Cohort Study. *Pediatr Obes*. 2013.
61. Oken E, Levitan EB, Gillman MW. Maternal smoking during pregnancy and child overweight: systematic review and meta-analysis. *Int J Obes (Lond)*. 2008;32(2):201-10.
62. Woo Baidal JA, Locks LM, Cheng ER, Blake-Lamb TL, Perkins ME, Taveras EM. Risk Factors for Childhood Obesity in the First 1,000 Days: A Systematic Review. *Am J Prev Med*. 2016;50(6):761-79.
63. Riedel C, Schonberger K, Yang S, et al. Parental smoking and childhood obesity: higher effect estimates for maternal smoking in pregnancy compared with paternal smoking--a meta-analysis. *Int J Epidemiol*. 2014;43(5):1593-606.
64. Josefson JL, Hoffmann JA, Metzger BE. Excessive weight gain in women with a normal pre-pregnancy BMI is associated with increased neonatal adiposity. *Pediatr Obes*. 2013.
65. Ludwig DS, Rouse HL, Currie J. Pregnancy Weight Gain and Childhood Body Weight: A Within-Family Comparison. *PLoS Med*. 2013;10(10):e1001521.
66. Wrotniak BH, Shults J, Butts S, Stettler N. Gestational weight gain and risk of overweight in the offspring at age 7 y in a multicenter, multiethnic cohort study. *Am J Clin Nutr*. 2008;87(6):1818-24.
67. Yu ZB, Han SP, Zhu GZ, et al. Birth weight and subsequent risk of obesity: a systematic review and meta-analysis. *Obes Rev*. 2011;12(7):525-42.
68. Qiao Y, Ma J, Wang Y, et al. Birth weight and childhood obesity: a 12-country study. *Int J Obes Suppl*. 2015;5(Suppl 2):S74-9.
69. Ong KK. Size at birth, postnatal growth and risk of obesity. *Horm Res*. 2006;65 Suppl 3:65-9.
70. Durmus B, Heppe DH, Gishti O, et al. General and abdominal fat outcomes in school-age children associated with infant breastfeeding patterns. *Am J Clin Nutr*. 2014;99(6):1351-8.
71. Huh SY, Rifas-Shiman SL, Taveras EM, Oken E, Gillman MW. Timing of solid food introduction and risk of obesity in preschool-aged children. *Pediatrics*. 2011;127(3):e544-51.
72. Ventura AK, Worobey J. Early influences on the development of food preferences. *Curr Biol*. 2013;23(9):R401-8.
73. Birch LL, Fisher JO. Development of eating behaviors among children and adolescents. *Pediatrics*. 1998;101(3 Pt 2):539-49.
74. Smithers LG, Golley RK, Brazionis L, Lynch JW. Characterizing whole diets of young children from developed countries and the association between diet and health: a systematic review. *Nutr Rev*. 2011;69(8):449-67.
75. Fildes A, van Jaarsveld CH, Llewellyn CH, Fisher A, Cooke L, Wardle J. Nature and nurture in children's food preferences. *Am J Clin Nutr*. 2014;99(4):911-7.
76. Oude Luttikhuis H, Baur L, Jansen H, et al. Interventions for treating obesity in children. *Cochrane Database Syst Rev*. 2009(1):CD001872.
77. DiSantis KI, Birch LL, Davey A, et al. Plate size and children's appetite: effects of larger dishware on self-served portions and intake. *Pediatrics*. 2013;131(5):e1451-8.
78. Nicklas TA, Hayes D, American Dietetic A. Position of the American Dietetic Association: nutrition guidance for healthy children ages 2 to 11 years. *J Am Diet Assoc*. 2008;108(6):1038-44, 46-7.
79. Benjamin Neelon SE, Briley ME, American Dietetic A. Position of the American Dietetic Association: benchmarks for nutrition in child care. *J Am Diet Assoc*. 2011;111(4):607-15.
80. de Ruyter JC, Olthof MR, Seidell JC, Katan MB. A trial of sugar-free or sugar-sweetened beverages and body weight in children. *N Engl J Med*. 2012;367(15):1397-406.
81. Ludwig DS, Peterson KE, Gortmaker SL. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet*. 2001;357(9255):505-8.
82. Muckelbauer R, Barbosa CL, Mittag T, Burkhardt K, Mikelaishvili N, Muller-Nordhorn J. Association between water consumption and body weight outcomes in children and adolescents: a systematic review. *Obesity (Silver Spring)*. 2014;22(12):2462-75.
83. Burrows TL, Martin RJ, Collins CE. A systematic review of the validity of dietary assessment methods in children when compared with the method of doubly labeled water. *J Am Diet Assoc*. 2010;110(10):1501-10.
84. Ambrosini GL. Childhood dietary patterns and later obesity: a review of the evidence. *Proc Nutr Soc*. 2014;73(1):137-46.
85. Timmons BW, Naylor PJ, Pfeiffer KA. Physical activity for preschool children--how much and how? *Can J Public Health*. 2007;98 Suppl 2:S122-34.
86. Kuzik N, Carson V. The association between physical activity, sedentary behavior, sleep, and body mass index z-scores in different settings among toddlers and preschoolers. *BMC Pediatr*. 2016;16(1):100.
87. Tanaka C, Reilly JJ, Huang WY. Longitudinal changes in objectively measured sedentary behaviour and their relationship with adiposity in children and adolescents: systematic review and evidence appraisal. *Obes Rev*. 2014;15(10):791-803.

88. Moraeus L, Lissner L, Olsson L, Sjoberg A. Age and time effects on children's lifestyle and overweight in Sweden. *BMC Public Health*. 2015;15:355.
89. Miguel-Berges ML, Santaliestra-Pasias AM, Mouratidou T, et al. Associations between food and beverage consumption and different types of sedentary behaviours in European preschoolers: the ToyBox-study. *Eur J Nutr*. 2016.
90. Marshall SJ, Biddle SJ, Gorely T, Cameron N, Murdey I. Relationships between media use, body fatness and physical activity in children and youth: a meta-analysis. *Int J Obes Relat Metab Disord*. 2004;28(10):1238-46.
91. Olafsdottir S, Berg C, Eiben G, et al. Young children's screen activities, sweet drink consumption and anthropometry: results from a prospective European study. *Eur J Clin Nutr*. 2014;68(2):223-8.
92. Hurley KM, Cross MB, Hughes SO. A systematic review of responsive feeding and child obesity in high-income countries. *J Nutr*. 2011;141(3):495-501.
93. Webber L, Hill C, Saxton J, Van Jaarsveld CH, Wardle J. Eating behaviour and weight in children. *Int J Obes (Lond)*. 2009;33(1):21-8.
94. Wardle J, Guthrie CA, Sanderson S, Rapoport L. Development of the Children's Eating Behaviour Questionnaire. *J Child Psychol Psychiatry*. 2001;42(7):963-70.
95. Magarey A, Mauch C, Mallan K, et al. Child dietary and eating behavior outcomes up to 3.5 years after an early feeding intervention: The NOURISH RCT. *Obesity (Silver Spring)*. 2016.
96. Edmunds LD, Rennie KL, King S, Mayhew H. Experiences of those taking part in the BeeZee Bodies family-based weight management intervention: A qualitative evaluation. *International Journal of Child Health and Nutrition*. 2014;3(4):163-9.
97. Wardle J, Carnell S, Cooke L. Parental control over feeding and children's fruit and vegetable intake: how are they related? *J Am Diet Assoc*. 2005;105(2):227-32.
98. Birch LL, Fisher JO, Davison KK. Learning to overeat: maternal use of restrictive feeding practices promotes girls' eating in the absence of hunger. *Am J Clin Nutr*. 2003;78(2):215-20.
99. Fisher JO, Birch LL. Restricting access to foods and children's eating. *Appetite*. 1999;32(3):405-19.
100. Ventura AK, Birch LL. Does parenting affect children's eating and weight status? *Int J Behav Nutr Phys Act*. 2008;5:15.
101. Birch LL, Fisher JO, Grimm-Thomas K, Markey CN, Sawyer R, Johnson SL. Confirmatory factor analysis of the Child Feeding Questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite*. 2001;36(3):201-10.
102. Webber L, Cooke L, Hill C, Wardle J. Associations between children's appetitive traits and maternal feeding practices. *J Am Diet Assoc*. 2010;110(11):1718-22.
103. Nowicka P, Sorjonen K, Pietrobelli A, Flodmark CE, Faith MS. Parental feeding practices and associations with child weight status. Swedish validation of the Child Feeding Questionnaire finds parents of 4-year-olds less restrictive. *Appetite*. 2014;81C:232-41.
104. Faith MS, Scanlon KS, Birch LL, Francis LA, Sherry B. Parent-child feeding strategies and their relationships to child eating and weight status. *Obes Res*. 2004;12(11):1711-22.
105. Hughes SO, Power TG, O'Connor TM, Orlet Fisher J, Chen TA. Maternal Feeding Styles and Food Parenting Practices as Predictors of Longitudinal Changes in Weight Status in Hispanic Preschoolers from Low-Income Families. *J Obes*. 2016;2016:7201082.
106. Jansen PW, Roza SJ, Jaddoe VW, et al. Children's eating behavior, feeding practices of parents and weight problems in early childhood: results from the population-based Generation R Study. *Int J Behav Nutr Phys Act*. 2012;9:130.
107. Afonso L, Lopes C, Severo M, et al. Bidirectional association between parental child-feeding practices and body mass index at 4 and 7 y of age. *Am J Clin Nutr*. 2016;103(3):861-7.
108. Steinsbekk S, Belsky J, Wichstrom L. Parental Feeding and Child Eating: An Investigation of Reciprocal Effects. *Child Dev*. 2016.
109. Webber L, Cooke L, Hill C, Wardle J. Child adiposity and maternal feeding practices: a longitudinal analysis. *Am J Clin Nutr*. 2010;92(6):1423-8.
110. Gregory JE, Paxton SJ, Brozovic AM. Pressure to eat and restriction are associated with child eating behaviours and maternal concern about child weight, but not child body mass index, in 2- to 4-year-old children. *Appetite*. 2010;54(3):550-6.
111. Pesch MH, Rizk M, Appugliese DP, Rosenblum KL, Miller A, Lumeng JC. Maternal concerns about children overeating among low-income children. *Eat Behav*. 2016;21:220-7.
112. Darling N, Steinberg L. Parenting style as context - an integrative model. *Psychol Bull*. 1993;113(3):487-96.
113. Sleddens EF, Gerards SM, Thijs C, de Vries NK, Kremers SP. General parenting, childhood overweight and obesity-inducing behaviors: a review. *Int J Pediatr Obes*. 2011;6(2-2):e12-27.
114. Ek A, Chamberlain KL, Ejderhamn J, et al. The More and Less Study: a randomized controlled trial testing different approaches to treat obesity in preschoolers. *BMC Public Health*. 2015;15(1):735.
115. Chamberlain P, Price J, Leve LD, Laurent H, Landsverk JA, Reid JB. Prevention of behavior problems for children in foster care: outcomes and mediation effects. *Prev Sci*. 2008;9(1):17-27.

116. Price JM, Chamberlain P, Landsverk J, Reid JB, Leve LD, Laurent H. Effects of a foster parent training intervention on placement changes of children in foster care. *Child Maltreat*. 2008;13(1):64-75.
117. Horwitz SM, Chamberlain P, Landsverk J, Mullican C. Improving the mental health of children in child welfare through the implementation of evidence-based parenting interventions. *Adm Policy Ment Health*. 2010;37(1-2):27-39.
118. Patterson GR, Forgatch MS, Degarmo DS. Cascading effects following intervention. *Dev Psychopathol*. 2010;22(4):949-70.
119. Patterson GR. A performance theory for coercive family interactions In: Cairns R, editor. Social interaction: Methods, analysis, and illustration Hillsdale, NJ: Lawrence Erlbaum Associates, Inc; 1979. p. 119-62.
120. Moens E, Braet C. Training parents of overweight children in parenting skills: a 12-month evaluation. *Behav Cogn Psychother*. 2012;40(1):1-18.
121. Golley RK, Magarey AM, Baur LA, Steinbeck KS, Daniels LA. Twelve-month effectiveness of a parent-led, family-focused weight-management program for prepubertal children: a randomized, controlled trial. *Pediatrics*. 2007;119(3):517-25.
122. West F, Sanders MR, Cleghorn GJ, Davies PS. Randomised clinical trial of a family-based lifestyle intervention for childhood obesity involving parents as the exclusive agents of change. *Behav Res Ther*. 2010;48(12):1170-9.
123. Magarey AM, Perry RA, Baur LA, et al. A parent-led family-focused treatment program for overweight children aged 5 to 9 years: the PEACH RCT. *Pediatrics*. 2011;127(2):214-22.
124. Gerards SM, Dagnelie PC, Gubbels JS, et al. The effectiveness of lifestyle triple P in the Netherlands: a randomized controlled trial. *PLoS One*. 2015;10(4):e0122240.
125. Doring N, Ghaderi A, Bohman B, et al. Motivational Interviewing to Prevent Childhood Obesity: A Cluster RCT. *Pediatrics*. 2016;137(5).
126. De Henauw S, Huybrechts I, De Bourdeaudhuij I, et al. Effects of a community-oriented obesity prevention programme on indicators of body fatness in preschool and primary school children. Main results from the IDEFICS study. *Obes Rev*. 2015;16 Suppl 2:16-29.
127. Pinket AS, Van Lippevelde W, De Bourdeaudhuij I, et al. Effect and Process Evaluation of a Cluster Randomized Control Trial on Water Intake and Beverage Consumption in Preschoolers from Six European Countries: The ToyBox-Study. *PLoS One*. 2016;11(4):e0152928.
128. Peirson L, Fitzpatrick-Lewis D, Morrison K, et al. Prevention of overweight and obesity in children and youth: a systematic review and meta-analysis. *CMAJ Open*. 2015;3(1):E23-33.
129. Seburg EM, Olson-Bullis BA, Bredeson DM, Hayes MG, Sherwood NE. A Review of Primary Care-Based Childhood Obesity Prevention and Treatment Interventions. *Curr Obes Rep*. 2015;4(2):157-73.
130. Hoelscher DM, Kirk S, Ritchie L, Cunningham-Sabo L, Academy Positions C. Position of the Academy of Nutrition and Dietetics: interventions for the prevention and treatment of pediatric overweight and obesity. *J Acad Nutr Diet*. 2013;113(10):1375-94.
131. Danielsson P, Svensson V, Kowalski J, Nyberg G, Ekblom O, Marcus C. Importance of age for 3-year continuous behavioral obesity treatment success and dropout rate. *Obes Facts*. 2012;5(1):34-44.
132. Reinehr T, Kleber M, Lass N, Toschke AM. Body mass index patterns over 5 y in obese children motivated to participate in a 1-y lifestyle intervention: age as a predictor of long-term success. *Am J Clin Nutr*. 2010;91(5):1165-71.
133. Janicke DM, Sallinen BJ, Perri MG, et al. Comparison of parent-only vs family-based interventions for overweight children in underserved rural settings: outcomes from project STORY. *Arch Pediatr Adolesc Med*. 2008;162(12):1119-25.
134. Golan M, Crow S. Targeting parents exclusively in the treatment of childhood obesity: long-term results. *Obes Res*. 2004;12(2):357-61.
135. Foster BA, Farragher J, Parker P, Sosa ET. Treatment Interventions for Early Childhood Obesity: A Systematic Review. *Acad Pediatr*. 2015;15(4):353-61.
136. Colquitt JL, Loveman E, O'Malley C, et al. Diet, physical activity, and behavioural interventions for the treatment of overweight or obesity in preschool children up to the age of 6 years. *Cochrane Database Syst Rev*. 2016;3:CD012105.
137. Bocca G, Corpeleijn E, van den Heuvel ER, Stolk RP, Sauer PJ. Three-year follow-up of 3-year-old to 5-year-old children after participation in a multidisciplinary or a usual-care obesity treatment program. *Clin Nutr*. 2014;33(6):1095-100.
138. Quattrin T, Roemmich JN, Paluch R, Yu J, Epstein LH, Ecker MA. Treatment outcomes of overweight children and parents in the medical home. *Pediatrics*. 2014;134(2):290-7.
139. Stark LJ, Clifford LM, Towner EK, et al. A pilot randomized controlled trial of a behavioral family-based intervention with and without home visits to decrease obesity in preschoolers. *J Pediatr Psychol*. 2014;39(9):1001-12.
140. Stark LJ, Spear S, Boles R, et al. A pilot randomized controlled trial of a clinic and home-based behavioral intervention to decrease obesity in preschoolers. *Obesity (Silver Spring)*. 2011;19(1):134-41.
141. Quattrin T, Roemmich JN, Paluch R, Yu J, Epstein LH, Ecker MA. Efficacy of family-based weight control program for preschool children in primary care. *Pediatrics*. 2012;130(4):660-6.

142. Taveras EM, Gortmaker SL, Hohman KH, et al. Randomized controlled trial to improve primary care to prevent and manage childhood obesity: the High Five for Kids study. *Arch Pediatr Adolesc Med*. 2011;165(8):714-22.
143. van Grieken A, Veldhuis L, Renders CM, et al. Population-based childhood overweight prevention: outcomes of the 'Be active, eat right' study. *PLoS One*. 2013;8(5):e65376.
144. Taylor RW, Cox A, Knight L, et al. A Tailored Family-Based Obesity Intervention: A Randomized Trial. *Pediatrics*. 2015;136(2):281-9.
145. Collins CE, Okely AD, Morgan PJ, et al. Parent diet modification, child activity, or both in obese children: an RCT. *Pediatrics*. 2011;127(4):619-27.
146. Munsch S, Roth B, Michael T, et al. Randomized controlled comparison of two cognitive behavioral therapies for obese children: mother versus mother-child cognitive behavioral therapy. *Psychother Psychosom*. 2008;77(4):235-46.
147. Boutelle KN, Cafri G, Crow SJ. Parent-only treatment for childhood obesity: a randomized controlled trial. *Obesity (Silver Spring)*. 2011;19(3):574-80.
148. Janicke DM, Steele RG, Gayes LA, et al. Systematic review and meta-analysis of comprehensive behavioral family lifestyle interventions addressing pediatric obesity. *J Pediatr Psychol*. 2014;39(8):809-25.
149. Golan M, Weizman A, Apter A, Fainaru M. Parents as the exclusive agents of change in the treatment of childhood obesity. *Am J Clin Nutr*. 1998;67(6):1130-5.
150. Janicke DM, Sallinen BJ, Perri MG, Lutes LD, Silverstein JH, Brumback B. Comparison of program costs for parent-only and family-based interventions for pediatric obesity in medically underserved rural settings. *J Rural Health*. 2009;25(3):326-30.
151. Andreassen P, Gron L, Roessler KK. Hiding the plot: parents' moral dilemmas and strategies when helping their overweight children lose weight. *Qual Health Res*. 2013;23(10):1333-43.
152. Kremers S, Sleddens E, Gerards S, et al. General and food-specific parenting: measures and interplay. *Child Obes*. 2013;9 Suppl:S22-31.
153. Baranowski T, O'Connor T, Hughes S, et al. Houston ... We Have a Problem! Measurement of Parenting. *Child Obes*. 2013.
154. Streiner DL, Norman GR. Health measurement scales A practical guide to their development and use. 4th ed. New York: Oxford University Press; 2008.
155. Scientific Advisory Committee of the Medical Outcomes Trust. Assessing health status and quality-of-life instruments: attributes and review criteria. *Qual Life Res*. 2002;11(3):193-205.
156. Chen TA, O'Connor TM, Hughes SO, et al. TV parenting practices: is the same scale appropriate for parents of children of different ages? *Int J Behav Nutr Phys Act*. 2013;10:41.
157. Sobko T, Svensson V, Ek A, et al. A randomised controlled trial for overweight and obese parents to prevent childhood obesity--Early STOPP (STockholm Obesity Prevention Program). *BMC Public Health*. 2011;11:336.
158. Norman GR, Streiner, D.L. Biostatistics: The Bare Essentials. 3 rd ed. Shelton: People's medical publishing house; 2009.
159. Ong KK, Loos RJ. Rapid infancy weight gain and subsequent obesity: systematic reviews and hopeful suggestions. *Acta Paediatr*. 2006;95(8):904-8.
160. Wikland KA, Luo ZC, Niklasson A, Karlberg J. Swedish population-based longitudinal reference values from birth to 18 years of age for height, weight and head circumference. *Acta Paediatr*. 2002;91(7):739-54.
161. West F, Sanders MR. The Lifestyle Behaviour Checklist: a measure of weight-related problem behaviour in obese children. *Int J Pediatr Obes*. 2009;4(4):266-73.
162. West F, Morawska A, Joughin K. The Lifestyle Behaviour Checklist: evaluation of the factor structure. *Child Care Health Dev*. 2010;36(4):508-15.
163. West F. Lifestyle Triple P Project: exploring the link between parenting and childhood obesity: The University of Queensland; 2007.
164. de Lauzon-Guillain B, Oliveira A, Charles MA, et al. A review of methods to assess parental feeding practices and preschool children's eating behavior: the need for further development of tools. *J Acad Nutr Diet*. 2012;112(10):1578-602, 602 e1-8.
165. Svensson V, Lundborg L, Cao Y, Nowicka P, Marcus C, Sobko T. Obesity related eating behaviour patterns in Swedish preschool children and association with age, gender, relative weight and parental weight--factorial validation of the Children's Eating Behaviour Questionnaire. *Int J Behav Nutr Phys Act*. 2011;8:134.
166. De Vet HC, Terwee CB, Mokkink LB, Knol DL. Measurement in Medicine: A practical guide. 1 st ed. New York: Cambridge University Press; 2011.
167. Hagell P, Hedin PJ, Meads DM, Nyberg L, McKenna SP. Effects of method of translation of patient-reported health outcome questionnaires: a randomized study of the translation of the Rheumatoid Arthritis Quality of Life (RAQoL) Instrument for Sweden. *Value Health*. 2010;13(4):424-30.
168. Trust SACotMO. Assessing health status and quality-of-life instruments: attributes and review criteria. *Qual Life Res*. 2002;11(3):193-205.
169. Willis GB. Cognitive Interviewing A Tool for Improving Questionnaire Design. 1st ed. Thousand Oaks: Sage Publications; 2005.

170. Hälso- och sjukvårdsnämndens förvaltning Sll. Handlingsprogram mot övervikt och fetma 2016-2020. Stockholm.: 2016.
171. Danielsson P, Bohlin A, Bendito A, Svensson A, Klaesson S. Five-year outpatient programme that provided children with continuous behavioural obesity treatment enjoyed high success rate. *Acta Paediatr*. 2016.
172. Bandura A. Social Learning Theory. New York: General Learning Press; 1971.
173. Patterson GR. Performance models for parenting: A social interactional perspective. In: Grusec JE, Kuczynski, L, editor. Parenting and children's internalization of values: A handbook of contemporary theory. New York: John Wiley & Sons; 1997. p. 193-235.
174. Bandura A. Vicarious and self-reinforcement processes In: Glaser R, editor. The nature of reinforcement. New York: Academic Press; 1971. p. 228-78.
175. Rhee KE, Jelalian E, Boutelle K, Dickstein S, Seifer R, Wing R. Warm Parenting Associated with Decreasing or Stable Child BMI during Treatment. *Child Obes*. 2016;12(2):94-102.
176. Bronfenbrenner U. The Ecology of Human Development: Experiments by nature and design. Cambridge, MA: Harvard University Press; 1979.
177. Cohen J. The Cost of Dichotomization. *Applied Psychological Measurement*. 1983;7(3):249-53.
178. Hu LT, Bentler PM. Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria Versus New Alternatives. *Structural Equation Modeling-a Multidisciplinary Journal*. 1999;6(1):1-55.
179. Bollen KA. Structural equations with latent variables. New York: John Wiley & Sons; 1989.
180. Jöreskog K. A general approach to confirmatory maximum likelihood factor analysis. *Psychometrika*. 1969;34(2):185-202.
181. Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology*. 2006;3(2):77-101.
182. Summerbell CD, Ashton V, Campbell KJ, Edmunds L, Kelly S, Waters E. Interventions for treating obesity in children. *Cochrane Database Syst Rev*. 2003(3):CD001872.
183. Ling J, Robbins LB, Wen F. Interventions to prevent and manage overweight or obesity in preschool children: A systematic review. *Int J Nurs Stud*. 2016;53:270-89.
184. Birch LL, Ventura AK. Preventing childhood obesity: what works? *Int J Obes (Lond)*. 2009;33 Suppl 1:S74-81.
185. Jang M, Chao A, Whittemore R. Evaluating Intervention Programs Targeting Parents to Manage Childhood Overweight and Obesity: A Systematic Review Using the RE-AIM Framework. *J Pediatr Nurs*. 2015;30(6):877-87.
186. Ahlborg T, Berg S, Lindvig J. Sense of coherence in first-time parents: a longitudinal study. *Scand J Public Health*. 2013;41(6):623-9.
187. Norman A, Berlin A, Sundblom E, Elinder LS, Nyberg G. Stuck in a vicious circle of stress. Parental concerns and barriers to changing children's dietary and physical activity habits. *Appetite*. 2015;87:137-42.
188. Ljungkrona-Falk L, Brekke H, Nyholm M. Swedish nurses encounter barriers when promoting healthy habits in children. *Health Promot Int*. 2014;29(4):730-8.
189. Gerards SM, Dagnelie PC, Jansen MW, De Vries NK, Kremers SP. Barriers to successful recruitment of parents of overweight children for an obesity prevention intervention: a qualitative study among youth health care professionals. *BMC Fam Pract*. 2012;13:37.
190. Ewald H, Kirby J, Rees K, Robertson W. Parent-only interventions in the treatment of childhood obesity: a systematic review of randomized controlled trials. *J Public Health (Oxf)*. 2014;36(3):476-89.
191. Jull A, Chen R. Parent-only vs. parent-child (family-focused) approaches for weight loss in obese and overweight children: a systematic review and meta-analysis. *Obes Rev*. 2013.
192. Loveman E, Al-Khudairy L, Johnson RE, et al. Parent-only interventions for childhood overweight or obesity in children aged 5 to 11 years. *Cochrane Database Syst Rev*. 2015;12:CD012008.
193. Golan M, Kaufman V, Shahar DR. Childhood obesity treatment: targeting parents exclusively v. parents and children. *Br J Nutr*. 2006;95(5):1008-15.
194. Eli K, Howell K, Fisher PA, Nowicka P. "Those comments last forever": parents and grandparents of preschoolers recount how they became aware of their own body weights as children. *PLoS One*. 2014;9(11):e111974.
195. Neumark-Sztainer D, Bauer KW, Friend S, Hannan PJ, Story M, Berge JM. Family weight talk and dieting: how much do they matter for body dissatisfaction and disordered eating behaviors in adolescent girls? *J Adolesc Health*. 2010;47(3):270-6.
196. Davison KK, Birch LL. Weight status, parent reaction, and self-concept in five-year-old girls. *Pediatrics*. 2001;107(1):46-53.
197. Montano Z, Smith JD, Dishion TJ, Shaw DS, Wilson MN. Longitudinal relations between observed parenting behaviors and dietary quality of meals from ages 2 to 5. *Appetite*. 2014;87C:324-9.
198. Gentile DA, Reimer RA, Nathanson AI, Walsh DA, Eisenmann JC. Protective effects of parental monitoring of children's media use: a prospective study. *JAMA Pediatr*. 2014;168(5):479-84.
199. Rhee KE, Lumeng JC, Appugliese DP, Kaciroti N, Bradley RH. Parenting styles and overweight status in first grade. *Pediatrics*. 2006;117(6):2047-54.

200. Stein RI, Epstein LH, Raynor HA, Kilanowski CK, Paluch RA. The influence of parenting change on pediatric weight control. *Obes Res*. 2005;13(10):1749-55.
201. Johnson L, Llewellyn CH, van Jaarsveld CH, Cole TJ, Wardle J. Genetic and environmental influences on infant growth: prospective analysis of the Gemini twin birth cohort. *PLoS One*. 2011;6(5):e19918.
202. Lindberg L, Ek A, Nyman J, Marcus C, Ulijaszek S, Nowicka P. Low grandparental social support combined with low parental socioeconomic status is closely associated with obesity in preschool-aged children: a pilot study. *Pediatr Obes*. 2016;11(4):313-6.
203. Broccoli S, Davoli AM, Bonvicini L, et al. Motivational Interviewing to Treat Overweight Children: 24-Month Follow-Up of a Randomized Controlled Trial. *Pediatrics*. 2016;137(1):1-10.
204. Wiegand S, Keller KM, Lob-Corzilius T, et al. Predicting weight loss and maintenance in overweight/obese pediatric patients. *Horm Res Paediatr*. 2014;82(6):380-7.
205. Taylor NJ, Sahota P, Sargent J, et al. Using intervention mapping to develop a culturally appropriate intervention to prevent childhood obesity: the HAPPY (Healthy and Active Parenting Programme for Early Years) study. *Int J Behav Nutr Phys Act*. 2013;10:142.
206. Galloway AT, Fiorito LM, Francis LA, Birch LL. 'Finish your soup': counterproductive effects of pressuring children to eat on intake and affect. *Appetite*. 2006;46(3):318-23.
207. Ainuki TA, R. Associations Between Children's Appetite Patterns and Maternal Feeding Practices. *Food and Nutrition Sciences*. 2011;2:228-34.
208. Carnell S, Benson L, Driggin E, Kolbe L. Parent feeding behavior and child appetite: Associations depend on feeding style. *Int J Eat Disord*. 2014;47(7):705-9.
209. Rodgers RF, Paxton SJ, Massey R, et al. Maternal feeding practices predict weight gain and obesogenic eating behaviors in young children: a prospective study. *Int J Behav Nutr Phys Act*. 2013;10:24.
210. Gregory JE, Paxton SJ, Brozovic AM. Maternal feeding practices, child eating behaviour and body mass index in preschool-aged children: a prospective analysis. *Int J Behav Nutr Phys Act*. 2010;7:55.
211. Webber L, Hill C, Cooke L, Carnell S, Wardle J. Associations between child weight and maternal feeding styles are mediated by maternal perceptions and concerns. *Eur J Clin Nutr*. 2010;64(3):259-65.
212. May AL, Donohue M, Scanlon KS, et al. Child-feeding strategies are associated with maternal concern about children becoming overweight, but not children's weight status. *J Am Diet Assoc*. 2007;107(7):1167-75.
213. Regber S, Novak M, Eiben G, et al. Parental perceptions of and concerns about child's body weight in eight European countries--the IDEFICS study. *Pediatr Obes*. 2013;8(2):118-29.
214. Ogden J, Reynolds R, Smith A. Expanding the concept of parental control: a role for overt and covert control in children's snacking behaviour? *Appetite*. 2006;47(1):100-6.
215. Rollins BY, Loken E, Savage JS, Birch LL. Maternal controlling feeding practices and girls' inhibitory control interact to predict changes in BMI and eating in the absence of hunger from 5 to 7 y. *Am J Clin Nutr*. 2014;99(2):249-57.
216. Carnell S, Wardle J. Appetite and adiposity in children: evidence for a behavioral susceptibility theory of obesity. *Am J Clin Nutr*. 2008;88(1):22-9.
217. Steinsbekk S, Wichstrom L. Predictors of Change in BMI From the Age of 4 to 8. *J Pediatr Psychol*. 2015.
218. Steinsbekk S, Belsky D, Guzey IC, Wardle J, Wichstrom L. Polygenic Risk, Appetite Traits, and Weight Gain in Middle Childhood: A Longitudinal Study. *JAMA Pediatr*. 2016;170(2):e154472.
219. Svensson V. Family-related obesity risk factors and dietary behaviours in high-risk populations: Associations with child weight development. Universitetsservice AB, Solna: Karolinska Institutet; 2014.
220. Gerards SM, Hummel K, Dagnelie PC, de Vries NK, Kremers SP. Parental self-efficacy in childhood overweight: validation of the Lifestyle Behavior Checklist in the Netherlands. *Int J Behav Nutr Phys Act*. 2013;10:7.
221. Carnell S, Wardle J. Measuring behavioural susceptibility to obesity: validation of the child eating behaviour questionnaire. *Appetite*. 2007;48(1):104-13.
222. Viana V, Sinde S, Saxton JC. Children's Eating Behaviour Questionnaire: associations with BMI in Portuguese children. *Br J Nutr*. 2008;100(2):445-50.
223. Sleddens EF, Kremers SP, Thijs C. The children's eating behaviour questionnaire: factorial validity and association with Body Mass Index in Dutch children aged 6-7. *Int J Behav Nutr Phys Act*. 2008;5:49.
224. Spence JC, Carson V, Casey L, Boule N. Examining behavioural susceptibility to obesity among Canadian pre-school children: the role of eating behaviours. *Int J Pediatr Obes*. 2011;6(2-2):e501-7.
225. Mallan KM, Liu WH, Mehta RJ, Daniels LA, Magarey A, Battistutta D. Maternal report of young children's eating styles. Validation of the Children's Eating Behaviour Questionnaire in three ethnically diverse Australian samples. *Appetite*. 2013;64:48-55.
226. Santos JL, Ho-Urriola JA, Gonzalez A, et al. Association between eating behavior scores and obesity in Chilean children. *Nutr J*. 2011;10:108.
227. Sparks MA, Radnitz CL. Confirmatory factor analysis of the Children's Eating Behaviour Questionnaire in a low-income sample. *Eat Behav*. 2012;13(3):267-70.
228. Cao YT, Svensson V, Marcus C, Zhang J, Zhang JD, Sobko T. Eating behaviour patterns in Chinese children aged 12-18 months and association with relative weight--factorial validation of the Children's Eating Behaviour Questionnaire. *Int J Behav Nutr Phys Act*. 2012;9:5.

229. Vandewater EA, Rideout VJ, Wartella EA, Huang X, Lee JH, Shim MS. Digital childhood: electronic media and technology use among infants, toddlers, and preschoolers. *Pediatrics*. 2007;119(5):e1006-15.
230. Hesketh KD, Hinkley T, Campbell KJ. Children's physical activity and screen time: qualitative comparison of views of parents of infants and preschool children. *Int J Behav Nutr Phys Act*. 2012;9:152.
231. Pesch MH, Wentz EE, Rosenblum KL, Appugliese DP, Miller AL, Lumeng JC. "You've got to settle down!": Mothers' perceptions of physical activity in their young children. *BMC Pediatr*. 2015;15:149.
232. Campbell K, Hesketh K, Silverii A, Abbott G. Maternal self-efficacy regarding children's eating and sedentary behaviours in the early years: associations with children's food intake and sedentary behaviours. *Int J Pediatr Obes*. 2010;5(6):501-8.
233. Hinkley T, Salmon J, Okely AD, Hesketh K, Crawford D. Correlates of preschool children's physical activity. *Am J Prev Med*. 2012;43(2):159-67.
234. Tiberio SS, Kerr DC, Capaldi DM, Pears KC, Kim HK, Nowicka P. Parental monitoring of children's media consumption: the long-term influences on body mass index in children. *JAMA Pediatr*. 2014;168(5):414-21.
235. Sleddens EF, Kremers SP, Stafleu A, Dagnelie PC, De Vries NK, Thijs C. Food parenting practices and child dietary behavior. Prospective relations and the moderating role of general parenting. *Appetite*. 2014;79:42-50.
236. Farrow C, Blissett J, Haycraft E. Does child weight influence how mothers report their feeding practices? *Int J Pediatr Obes*. 2011;6(3-4):306-13.
237. Bergmeier HJ, Skouteris H, Haycraft E, Haines J, Hooley M. Reported and observed controlling feeding practices predict child eating behavior after 12 months. *J Nutr*. 2015;145(6):1311-6.
238. Chamberlain P, Feldman SW, Wulczyn F, Saldana L, Forgatch M. Implementation and evaluation of linked parenting models in a large urban child welfare system. *Child Abuse Negl*. 2016;53:27-39.
239. Buchanan R, Chamberlain P, Price JM, Sprengelmeyer P. Examining the equivalence of fidelity over two generations of KEEP implementation: A preliminary analysis. *Child Youth Serv Rev*. 2013;35(1):188-93.
240. de Niet J, Timman R, Jongejan M, Passchier J, van den Akker E. Predictors of participant dropout at various stages of a pediatric lifestyle program. *Pediatrics*. 2011;127(1):e164-70.
241. Assmann C. Multiple imputation as one tool to provide longitudinal databases for modelling human height and weight development. *Eur J Clin Nutr*. 2016;70(6):653-5.
242. Azur MJ, Stuart EA, Frangakis C, Leaf PJ. Multiple imputation by chained equations: what is it and how does it work? *Int J Methods Psychiatr Res*. 2011;20(1):40-9.