Research Program

Background

Early effects of pediatric obesity Never before has the number of obese children been as large as today. Currently approximately 5% of children in Sweden are obese[1, 2]. This translates to 70,000 children in need of treatment to avoid significant future health-related comorbidities such as impaired glucose tolerance, cardiovascular disease, non-alcoholic fatty liver disease[3, 4], and premature death[5]. Early treatment can also protect children from social stigmatization that starts early; preference tests have demonstrated that preadolescent children prefer, as friends, children with a variety of handicaps to children who are overweight[6]. Such peer discrimination may be one of the causes that obese children assess their quality of life as lower than children who are diagnosed with cancer[7].

Scientific Questions

While early treatment has been recommended, the effectiveness of interventions for preschoolers is unclear[8]. We don't know the effectiveness of standard treatment currently recommended in health care setting at the age of 4[9]; we don't know the effects if the treatment is delayed, we don't know whether a treatment option specifically focusing on parenting training would be more effective than standard treatment, and lastly whether such parenting training program would be even more effective when extended with booster sessions. These are the questions that we aim to address in this research project.

The overall objective of this research program is to assess efficacy of early obesity treatment. To achieve this aim we will perform a randomized controlled trial (RCT) to evaluate efficacy of two treatment conditions for preschool obesity. These two treatments will also be compared with children randomized to a delayed treatment condition. Participants will be families with children aged 4–5 y (n=240) with obesity (as defined by international cut-offs[10]). They will be randomized to a treatment as usual (TAU) according to the Stockholm County program[9], parent training, or 2-year delayed TAU (D-TAU). Parent training will be based on the Parent Management Training Oregon Model (PMTO)[11] and adapted to address obesity by our pediatric obesity research team at Karolinska Institute (KI) in collaboration with the PMTO founders at the Oregon Social Learning Center (OSLC) in U.S. and child health care in Stockholm County.

Our central hypothesis is that early treatment of obesity will be effective at decreasing children' body mass index (BMI) SDS (primary outcome). In addition we hypothesize that modification of parental practices (in the context of 14 weekly group meetings) will have additional beneficial effects on child's body composition, metabolic and psychosocial health compared to TAU and D-TAU and that booster sessions are necessary for maintenance of treatment effect. The study has 4 specific aims:

Specific Aim #1: Determine effectiveness of two preschool obesity treatment programs (a parent training, n=120, and TAU, n=60) in improving body composition (BMI SDS as primary outcome), psychosocial and metabolic health, lifestyle choices and family functioning (secondary outcomes) in 240 families randomized to these conditions in comparison with D-TAU (n=60).
Specific Aim #2: Assess effectiveness of start of treatment at the age of 6 in D-TAU as compared to start of treatment at the age of 4 in TAU.
Specific Aim #3: Within PMTO, further test effectiveness of two conditions: standard parenting package program (14 wks) and an extended condition consisting of booster sessions during 1 year to evaluate if a prolonged care is necessary in maintaining intervention effects.
Specific Aim #4: Examine the central hypothesis with respect to whether changes in targeted parenting practices (e.g. skill encouragement, limit setting, monitoring, problem-solving, and positive involvement) will mediate child obesity outcomes. In addition we will examine moderators of intervention effects (e.g. socioeconomic status, parental adiposity and depression) within the context of conceptual model of this study.

Survey of the Field

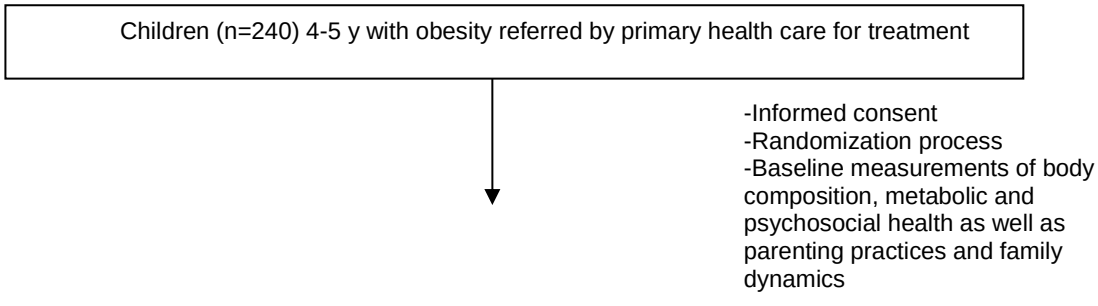
Although it has been shown that the development of weight status in children is a result of gene and environment interaction and that obesity cannot be fully explained by inappropriate parenting, the ways that parents shape a child's environment matter [12, 13]. However, few childhood obesity programs have been focused on parenting practices, and none has been targeted at families with preschoolers [14]. The results from studies with older children suggest the importance of parenting practices; Golan and colleagues have demonstrated some of the most robust findings, showing that a parent-centered (vs. child-centered) intervention is associated with lower attrition [15], greater weight reduction [16], and better long-term effects [17]. More recently, in a RCT with overweight children (mean age = 8.1 years), researchers confirmed that a parent-centered (vs. child-centered) program was more effective in reducing child body mass index (BMI) *z*-scores [18]. Unfortunately, Collins et al. did not evaluate which specific parenting changes were most effective in influencing child outcomes. Similarly, in another recent RCT evaluating a lifestyle-centered parenting program (Group Lifestyle Triple P) for treatment of prepubertal children with obesity, the parent-centered group showed increased confidence in managing child weight-related behavior and less frequent use of inconsistent or coercive parenting practices compared to the wait-list control group [19]. However, West et al. did not have sufficient power to identify mediators and moderators of intervention efficacy. *In summary, the scarcity of parent-focused studies and the limited understanding of mechanisms of change related to effective parental involvement in early childhood indicate a major knowledge gap.*

Project Description

Patients and methods Two hundred forty children aged 4-5 y will be referred by primary child health care to our research group at KI and then randomized to one of the three conditions: TAU (n=60), a parent training (n=120), and a delayed TAU (D-TAU) (see Figure 1).

The parent training condition will be further divided (using random assignment) into a group that receives the intervention for 14 wks (n=60) and a group that receives the intervention plus booster sessions at 8 wks intervals for 12 months. The inclusion criteria include obesity according to international cut-offs[10], no other underlying medical condition and sufficient ability to communicate in Swedish in order to participate in group treatment setting.

Parent training condition (including booster session condition) The parent training intervention will be adapted from the Parent Management Training-Oregon Model (PMTO) [20]. PMTO is based on Social Learning Theory developed by Gerald Patterson and colleagues at OSLC. Across numerous RCTs conducted over the past three decades, PMTO has been found to enhance effective parenting skills (skill encouragement, limit setting, monitoring, problem-solving, and positive involvement) and diminishing ineffective practices (negative reciprocity, escalation, and negative reinforcement). Changes in parenting associated with PMTO have been found to mediate improvements in child behaviors and other positive psychosocial outcomes lasting up to 9 years post intervention[11, 20-22]. Although PMTO was originally designed to target children's antisocial behavior, it is straightforward to adapt for this pediatric population. The detailed documentation of the method is one of its key strengths as it enables a quick and standardized implementation of the program with high fidelity. As a result, PMTO has been implemented in Norway (912 providers and 23,020 children treated as result of a nationwide implementation), Iceland (290 providers, 680 children treated), the Netherlands (63 providers, 1081 children treated), and Denmark (46 treatment providers). The successful international implementation is also evidence that cultural adaptation should not be an issue in PMTO as it's already been shown to be accepted in various settings.



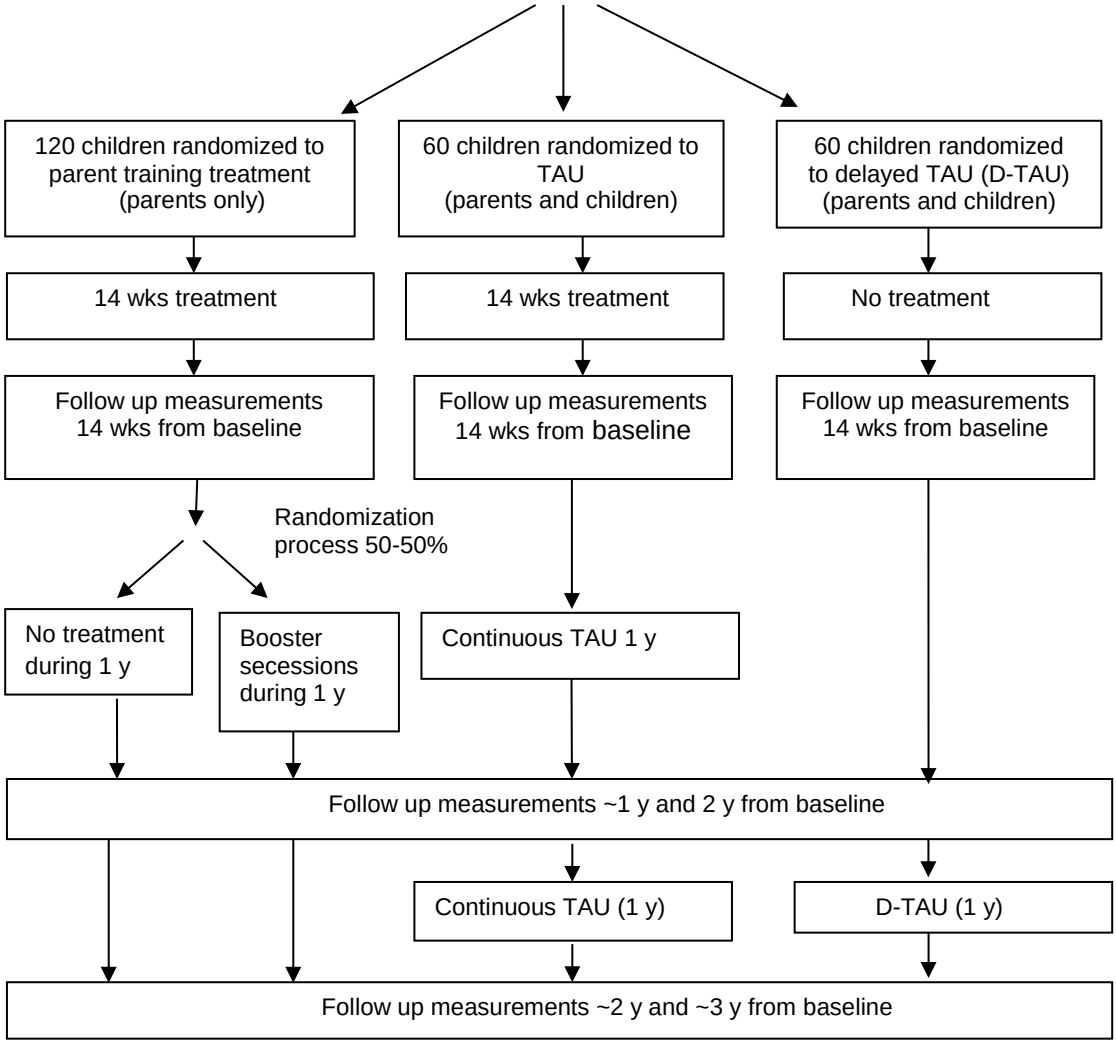


Figure 1. Study design.

Each of the 14 meetings (1.5h/wk) consists of a theoretical introduction to effective and ineffective parenting followed by role plays and home practice assignments (see Table 1). In the PMTO manual the sessions are described with precise instructions to group leaders (2 per group) and homework assignments to parents.

Table 1. The content of the parent management training sessions of PMTO (1.5h/week)

Week & Topic	**Week &Topic**
1: Working Through Change	8: Communicating with Children
2: Encouraging Cooperation	9: Problem Solving
3: Teaching New Behavior	10: Managing Conflict
4: Observing Emotions	11: Monitoring Children's Activities
5: Regulating Emotions	12: Promoting Play
6: Setting Limits	13: Building Good Food Environment
7: Following Through	14: Balancing Food and Play

Treatment as usual (TAU) and D-TAU The first treatment condition will receive a standard outpatient care based on lifestyle modifications as recommended by the action plan for Stockholm county[9]. TAU will be provided by local pediatricians.

The children randomized to delayed intervention (D-TAU) will wait for treatment during the active phase of the study, which is approximately 2 y. This design will allow us to assess the

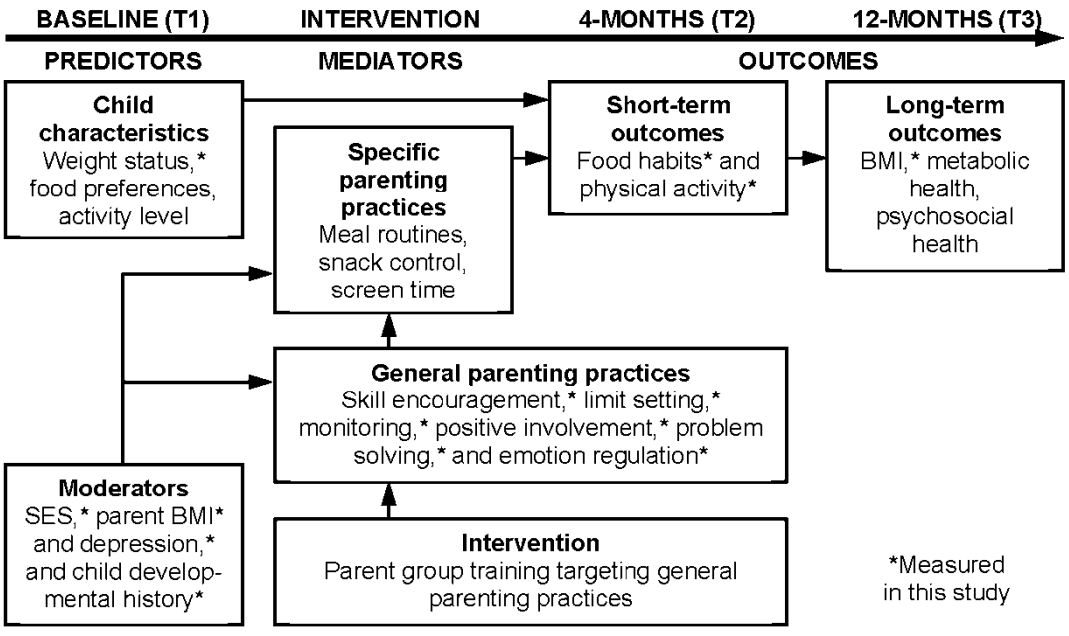
effects of a later intervention, which mirrors the experiences of many families who either decline treatment or are on the waiting list for treatment due to the lack of resources. In addition, many times parents prefer to wait with treatment hoping that obesity will resolve by itself. In fact, according to the Swedish Obesity Treatment Weight Registry (e-BORIS.se), the usual referral age of children is eleven (unpublished data).

Proposed conceptual model According to our conceptual model (see Figure 2), changes in general parenting (e.g., limit setting) will modify specific parenting practices (e.g., meal routines) that will consequently influence the child home environment and result in child obesity outcomes such as BMI *z*-scores. Five dimensions of positive parenting form the cornerstone of PMTO. *Skill encouragement* involves the use of scaffolding (i.e., breaking complex behaviors into achievable steps and encouraging approximations toward the goal) and positive reinforcement to teach new behaviors. *Limit setting* is designed to discourage deviant behaviors with contingent small sanctions. *Monitoring* involves parental tracking of child whereabouts, activities, and behaviors and the provision of appropriate adult supervision. *Problem solving* involves setting goals, developing strategies to achieve goals, committing to the decision, trying it out, and making relevant adjustments. *Positive involvement* involves how parents show love and interest to their child.

Outcome measurements. The primary outcome measurement is BMI SDS, which is the most commonly used indicator of changes in body composition in pediatric obesity studies, enabling comparison between other studies[8].

The power calculation is based on the data from Kleber et al[23] and BORIS, data. We

Figure 2. Conceptual model of the relationships between parenting and child weight.



hypothesize that TAU will be slightly less effective (-0.3 BMI SDS versus -0.4) than the intensive treatment obtained in that study, but on the other hand we expect lower dropout rate (20% vs 24%). Based on data from BORIS, we probably overestimate the dropout rate. We hypothesize that PMTO is twice as good as TAU i.e., -0.6 BMI SDS during the first year. We also assume that D-TAU will have the same BMI SDS at the end of the first year which also is a conservative assumption as obese children in this age group usually show an increase in BMI SDS (Kleber). Furthermore, the calculation is based on group comparisons at the end of year one, which is more conservative than comparisons of BMI SDS changes over the year. Based on these assumptions we will require 53 children in each group ($p<0.05$ and power 95%) to be able to detect changes both between TAU and PMTO and TAU and D-TAU.

Furthermore following secondary outcomes will be measured at baseline and at follow ups:

- body composition (waist circumference) in parents and children,
- metabolic health in children (blood pressure, lipids, fasting glucose, insulin, and homeostasis model assessment of insulin resistance [HOMA-IR]),
- family functioning with the Family Assessment Device[24],
- child's functioning with the Child Behavior Check List[25],
- parent's functioning with the Beck Depression Inventory[26],
- socioeconomic status with a questionnaire developed for this study based on routine assessments in the Child Health Care (Barnahålsovården) and a questionnaire used at the Oregon Social Learning Center (OSLC) for similar population (families with young children).
- eating behavior and physical activity patterns with the Lifestyle Behavior Checklist [27] a questionnaire specifically developed and tested for families with obese children in preschool age.
- parenting practices such as:
  a. *Skill encouragement*: with Family Activities Checklist, an unpublished OSLC Instrument.
  b. *Limit setting* with the Discipline Questionnaire by Capaldi, D. M. (1995), an unpublished OSLC Instrument.
  c. *Monitoring and positive involvement* with the Monitor and Parent-Child Relationship Questionnaire, by Capaldi, D. M., & Wilson, J. (1998), an unpublished OSLC Instrument.
  d. *Problem solving* with the Problem-Solving Strategies Questionnaire, Parent/Partner Version[28] and the Conflict Tactics Scale Parent/Child Version (both adapted from Straus, 1979, Conflict Tactics Scale)
  e. *Emotion regulation* with the Family Event Checklist, an unpublished OSLC Instrument.

Analyses: For Aim #1-3 repeated measures analysis of variance will be used to see difference in child's BMI SDS (primary outcomes). For Aim #4 we will conduct path analyses to test hypothesized mediating effect of parenting practices on BMI SDS.

Significance

Our research project will expand our currently limited knowledge base of effects of early obesity treatment on children and their families. We will evaluate effectiveness of TAU versus parent training versus delayed TAU and examine whether changes in targeted parenting practices enhanced by parent training mediate child obesity outcomes. Such research will have an important positive impact by filling the current gap in the field of evidence-based practice of early obesity management by adding a broader comprehension and recognition of the family's role in shaping a child's lifestyle. This knowledge could be used in developing family-based programs targeting non-communicable pediatric diseases such as diabetes and asthma. Parents are children's most important teachers; therefore family-based programs hold considerable promise not only for combating obesity but also for improving children's life-course trajectories and the associated costs to the society.

The Research Team

The project will be performed at the Karolinska Institute that has an extensive experience in conducting pediatric studies. In addition, key researchers in the field will be involved.

Paulina Nowicka (PI): Dr Nowicka, PhD in pediatrics, a postdoctoral fellow at KI, will provide overall programmatic and administrative oversight to the project.

Claude Marcus (Co-Investigator). As the head of the obesity research team at Department of Pediatrics at KI, Dr. Marcus will assist Dr. Nowicka with the programmatic and administrative oversight of the project and ensuring its completion.

Marion Forgatch (Co-Investigator). As the PMTO founder Marion Forgatch, PhD in counseling psychology and senior research scientist at Oregon Social Learning Center, will provide direction and expertise in adapting PMTO for obesity and implementing the program within the Stockholm County.

Philip Fisher (Co-Investigator). Philip Fisher is Professor in Clinical Psychology at University of Oregon and senior research scientist at Oregon Social Learning Center with special interest in family-based interventions for preschoolers. Dr Fisher will assist in analyzing, interpreting and reporting the data.

Margareta Blennow (Co-Investigator). Margareta Blennow, MD, PhD is pediatrician and head of the Child Health Care Services in Southern Stockholm County. Dr Blennow will provide directions in recruitment process of patients within the framework presented at Stockholm County Action Plan[9].

Jan Ejderhamn (Co-Investigator). Jan Ejderhamn, MD, PhD, is in charge of standard obesity treatment in Stockholm. He will provide directions in optimal implementation of TAU condition in Stockholm county care system.

Hyoun Kim (Co-Investigator). Dr. Kim, based at Oregon Social Learning Center, will contribute with her extensive experience in methodological approach in longitudinal assessment of mediators and moderators in behavioral studies performed in pediatric populations. She will contribute to the conceptualization of the theoretical model underlying the intervention and statistical analysis of the results.

Ethical Considerations

The ethical approval will be obtained for this project as this project involves children. However, the risks imposed by this research project are low: the burden of the experiments for the research subjects is limited. In addition, the investigators have extensive experience conducting behavioral weight control studies, and active efforts will be taken at the staff of the Department of Pediatrics at KI to ensure the participating families' safety. By contrast, the increased prevalence of obesity in children necessitates the development and testing of effective modification strategies to lower risks related to obesity. Hence, the potential insights to be gained by this study outweigh the relatively minimal risks, even with regard to offering a delayed treatment condition. The delayed treatment is much more common than expected as the Swedish Weight Registry showed that the average referral age is 11.2 years. In the light of the high prevalence of delayed treatment it is even more critical to study its effects under controlled conditions. As the families in the delayed condition will be regularly contacted by research team, care will be taken to limit any adverse effects, which are unlikely.

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