Development and evaluation of the lifestyle intervention "Obeldicks light" for overweight children and adolescents

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Overview

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This study is registered at clinicaltrials.gov (NCT00422916).

Abstract

Aim:

Specific interventions for overweight but not obese children have not been established yet. Therefore we developed the methods, materials, and an evaluation protocol of a lifestyle intervention for overweight children based on an intervention for obese children.

Subjects and Methods:

The one-year lifestyle intervention "Obeldicks" for obese children compromised of physical activity, nutrition education, and behaviour counselling including an individual psychological care for both children and their parents was shortened reducing the amount of exercise training and individual counselling about 50% to a six-month intervention ("Obeldicks light").

Results:

The evaluation protocol was based on guidelines and validated instruments with available German healthy normal-weight controls. As ideal study design a multi-centre randomized controlled trail with the primary outcome change of weight status was identified. As secondary outcomes improvement of body composition (skinfold thicknesses; bioimpedance analyses), cardiovascular risk factors (blood pressure; waist circumference), quality of life, dietary habits, eating, exercise, and sedentary behaviour were established. Potential influencing factors for treatment success were identified such as parental BMI, ethnicity, and socioeconomic status. All proposed instruments were validated in the German representative KiGGS and DONALD study.

Conclusions: Adapting a well-established program for obese children to overweight children is an easy way to create a lifestyle intervention for overweight children. Our study protocol using instruments validated in German normal weight cohorts allows evaluating this new intervention.

Key words: lifestyle intervention, overweight, children, adolescents, randomized-controlled-trial, evaluation

Introduction

Overweight and obesity in childhood and adolescence is increasing world-wide (Ebbeling *et al.* 2002). Since overweight children tend to become obese adults and overweight affects both the children's health and their social integration (Ebbeling *et al.* 2002), effective treatments are needed. Overweight and its associated comorbidities such as hypertension, dyslipidemia, and disturbed glucose metabolism -which appear also frequently in children (I'Allemand *et al.* 2008;Reinehr *et al.* 2005a) - are likely associated with morbidity and premature death (Baker *et al.* 2007;Biro & Wien 2010). A large epidemiological study demonstrated the association between body-mass index (BMI) in childhood (7 through 13 years of age) and coronary heart disease (CHD) in adulthood (25 years of age or older) in a cohort of >270,000 Danish (Baker *et al.* 2007).

Guidelines recommend long-term outpatient training programs consisting of a combination of physical exercise, nutrition education, and behaviour counselling for obese children and adolescents, but only few programs have run and have been evaluated in the past (Oude *et al.* 2009;Monasta *et al.* 2010). A recent Cochrane review (Oude *et al.* 2009) concerning treatment in already obese children including 64 randomized controlled trials (RCTs) with 85,230 participants identified lifestyle interventions for obese children focused on physical activity and sedentary behavior in 12 studies, diet in 6 studies, and 36 concentrated on behaviorally orientated treatment programs. The studies included varied greatly in intervention design, outcome measurements and methodological quality. Meta-analysis indicated a reduction in weight at 6 and 12 months follow up in lifestyle interventions. While there is limited quality data to recommend one treatment program to be favored over another, this review shows that combined behavioral lifestyle interventions compared to standard care or self-help can produce a significant and clinically meaningful weight reduction in obese children and adolescents.

However, all RCTs have focused on obese children so far and even less is known about intervention effects in overweight children (Monasta *et al.* 2010;Oude *et al.* 2009). Probably, similar positive effects as in obese children can be reached in overweight children with less treatment intensity. Furthermore, the findings from interventions in obese children cannot be directly transferred to overweight children, since degree of overweight may influence the outcome. For example, lower weight may be associated with lower awareness of weight problems or less treatment motivation.

In this paper, we describe the development of a lifestyle intervention as well as the evaluation design to prove the effectiveness of this intervention in overweight children and adolescents.

Subjects/Methods

Development of the intervention "Obeldicks light"

The lifestyle intervention for overweight children and adolescents (called "Obeldicks light") was developed based on the experiences of the well-established "Obeldicks" intervention for obese children and adolescents. The name "Obeldicks" is adapted from the popular French obese comic figure "Obelix". This figure was chosen since it is associated with positive qualities such as strength.

Lifestyle intervention "Obeldicks"

The complete material and the exact description of the one-year lifestyle intervention "Obeldicks" is available as a training book (Reinehr *et al.* 2010a). Briefly, this intervention is based on physical activity, nutrition education, and behaviour counselling including individual psychological care of the child and his/her family (see figure 1). Inclusion criteria are obesity (BMI > 97th percentile (Kromeyer-Hauschild K *et al.* 2001)), age 8 to 16 years, apparently healthy and not on any medication, as well as attending regular school. An interdisciplinary team of paediatricians, diet-assistants, psychologists, and exercise physiologists is responsible for the training. Children older than 10 years are separated into gender-specific intervention groups, while younger boys and girls received the intervention together.

The lifestyle intervention "Obeldicks" for obese children and adolescents led to a reduction of overweight in 70% of the more than 1000 participants and even four years after end of intervention the weight reduction was sustained (Reinehr *et al.* 2010b). Furthermore, the reduction of weight was associated with an improvement of cardiovascular risk factors such as hypertension, dyslipidemia, disturbed glucose metabolism, and metabolic syndrome not only at the end of intervention but also one year after end of intervention (Reinehr *et al.* 2006). Additionally, this lifestyle intervention led to a reduction of carotid intima-media thickness (Wunsch *et al.* 2006), a predictive factor for atherosclerosis, heart attack, and stroke (Lorenz *et al.* 2007). Finally, the weight loss was also associated with an improvement of quality of life in the participants suggesting a clinical relevance not only from the medical point of view but also from the participants' point of view (Reinehr *et al.* 2005b). According to these promising results we decided to adopt this effective lifestyle

intervention to overweight but not obese (BMI >90th < 97th percentile (Kromeyer-Hauschild K *et al.* 2001)) children and called this new type of intervention “Obeldicks light”.

Lifestyle intervention “Obeldicks light”

Since the children were only overweight and not obese, the intervention was shortened from 1 year (“Obeldicks”) to 6 months (“Obeldicks light”). Compared to “Obeldicks”, the amount of physical activity training and the time- and cost-intensive individual counselling were reduced about 50%. We chose the same inclusion criteria as for “Obeldicks”. The differences between “Obeldicks” and “Obeldicks light” are demonstrated in figure 1. In “Obeldicks light”, the same training material as in “Obeldicks” (Reinehr *et al.* 2010a) are used.

-please insert figure 1 here-

Since in the lifestyle intervention “Obeldicks” the material in the nutrition and eating behaviour course as well as the sport games are age- and gender- specific for children > 10 years (Reinehr *et al.* 2010a), children and adolescents older than 10 years are divided into groups according to their sex and age while younger boys and girls received the intervention together.

The intervention team covers many disciplines and consists of paediatricians, diet-assistants, psychologists, and exercise physiologists trained in the methods of “Obeldicks”. All therapists have to build up a therapeutic alliance with the children and their families. They have to involve family members, adopt a non-blaming position, assume motivation, focus on small changes, identify the resources of the family, and create a positive climate by reframing (for details see (Flodmark 2005)).

The exercise therapy takes place once a week throughout the whole 6 intervention months. Apart from this, the training program “Obeldicks light” is divided into two phases (see figure 1): In the intensive phase (3 months), the children take part in the nutritional course and in the eating-behaviour course in six group-sessions each lasting for 1.5 hours. At the same time, the parents are invited to attend six parents’ evenings each lasting 1.5 hours. Furthermore, a session of individual nutrition counselling is provided. In the establishing phase (three months), one further session of individual nutrition counselling and three individual counselling sessions for the child and his/her parents (30 minutes/month) are offered.

The exercise therapy consists of trampoline jumping, jogging, ball games, dancing for girls, wrestling for boys, and instructions in physical activity as part of every-day life. Furthermore, reduction of the amount of time spent watching television or playing computer games is aimed by presenting alternative activity games, which can be played even with few friends without materials under all day circumstances.

The nutritional teaching is based on the prevention concept of the “Optimized mixed diet”. In this concept evidence-based recommendations are translated into food-based dietary guidelines also considering the dietary habits of children and families in Germany. In contrast to the present-day diet of children in Germany with a fat-content of 38% of energy intake (E%), 13 E% proteins, and 49 E% carbohydrates including 14 E% sugar, the “Optimized mixed diet” is both fat and sugar reduced and contains 30 E% fat, 15 E% proteins, and 55 E% carbohydrates including 5 E% sugar (Reinehr *et al.* 2010a). The children follow a “traffic-light system” when selecting their food. In this system, the foods and drinks available in Germany are separated according to their fat and sugar contents into “red = stop”, “orange = consider the amount”, and “green = o.k. when hungry or thirsty”.

The eating behaviour course is predominately behavioural-cognitive but also using systemic treatment approaches (Reinehr *et al.* 2010a): The training is based on behaviour contracts, booster systems, self reflecting curves, impulse control techniques, self instructions, cognitive restructuring, development of problem solving strategies, training of social competences, model learning via parents and prevention of relapses. One important aim of the eating behaviour course is to transfer rigid to flexible eating behaviour. The individual counselling sessions based on systemic and solution-focused theories are aimed to develop concrete solutions to change the family health behaviour consistently tailored to the individual family situation.

The intervention “Obeldicks light” is offered in two cities (Marl and Datteln) in north-west Germany.

Evaluation of the intervention “Obeldicks light”

To prove the effectiveness of the lifestyle intervention “Obeldicks light” we developed an evaluation protocol based on the recommendations of German guidelines for obese children and adolescents (www.a-g-a.de/Leitlinie.pdf 2011) and reviews (Ebbeling *et al.* 2002;Oude *et al.* 2009). We decided to perform a study with the best known evidence (Ebbeling *et al.* 2002;Oude *et al.* 2009), a randomized controlled multi-centre study to

prove the effectiveness of the lifestyle intervention for overweight children. Using a computer generated randomization list the children were randomized into an intervention group (6 months intervention) or into a control group (waiting period of 6 months). The study was an open randomized controlled trial since blinding was not possible due to the nature of the intervention.

The evaluation design is summarized in table 1. The primary goal was to reduce overweight and therefore change of weight status was the primary outcome. We decided to use the change of standard deviation BMI (BMI-SDS) as change of weight status since BMI is gender and age dependent in childhood. The degree of overweight was quantified using Cole's least mean square method, which normalized the BMI skewed distribution and expressed BMI as a standard deviation score (BMI-SDS) (Cole TJ 1990). Reference data recommended in guidelines for German children were used (Kromeyer-Hauschild K *et al.* 2001;www.a-g-a.de/Leitlinie.pdf 2011). For best available accurate measurements of BMI we measured height to the nearest centimetre using a rigid stadiometer and weight was measured unclothed to the nearest 0.1 kg using a calibrated balance scale.

-please insert table 1 here-

One of the secondary aims of the study was to describe the change of body composition. The gold standard to determine body composition is DEXA (www.a-g-a.de/Leitlinie.pdf 2011). However, this measurement is based on X-ray. Therefore we decided to analyze body composition by indirect measurements which are well related to DEXA measurements (Haroun *et al.* 2009;Slaughter *et al.* 1998). We measured skinfold thickness by one investigator at baseline and in follow-up to account for the problem of interpersonal variability which is a relevant confounder of this measurement. To reduce intrapersonal variability triceps and subscapularis skinfold thickness was measured twice using a caliper and averaged. The percentage of body fat was calculated with validated formulas (boys: body fat % = 0.783 x (subscapularis skinfold thickness + triceps skinfold thickness in mm) +1.6; girls: body fat % = 0.546 x (subscapularis skinfold thickness + triceps skinfold thickness in mm) +9.7) (Slaughter *et al.* 1998). Furthermore, an additional method of determining body composition was used to validate the body composition measurements (Haroun *et al.* 2009): Bioelectrical impedance was measured using leg-leg and hand-leg systems (BC418; TANITA, Uxbridge, UK). We used estimates of total body fat, lean body mass, and percentage body fat provided by the manufacturer's software based on age, gender, height, and weight. No information regarding the formulas used could be obtained from the manufacturer due to its commercially sensitive nature.

From a medical point of view an improvement of cardiovascular risk factors is demanded in a lifestyle intervention for overweight children. The main cardiovascular risk factors of overweight are central adiposity, hypertension, dyslipidemia, and disturbed glucose metabolism in childhood (Ebbeling *et al.* 2002;www.a-g-a.de/Leitlinie.pdf 2011). Since a vein puncture is necessary for the determination of lipids and glucose metabolism, we decided to measure blood pressure and waist circumference for body fat distribution to keep the expenditure as low as possible for the children in the study. Blood pressure was measured by one investigator at baseline and in follow-up to account for the problem of interpersonal variability which is a relevant confounder of this measurement. After a 10-minute rest in the supine position systolic and diastolic blood pressure were measured by using a calibrated sphygmomanometer at the right arm according to current guidelines (2004) twice and averaged to reduce intrapersonal variability. Furthermore, we determined waist circumference, which is highly predictive for cardiovascular risk factors and is a measurement of central adiposity (www.a-g-a.de/Leitlinie.pdf 2011). Waist circumference was measured by one investigator to account for the problem of interpersonal variability. Again, to reduce intrapersonal variability waist circumference was measured twice and averaged.

From the patient's point of view, improvement of quality of life represents the relevance of weight loss since overweight is associated with a reduced quality of life (Wille *et al.* 2008). We measured the quality of life by the parent and child version of the KINDL® questionnaire since all these questionnaires are validated and in use internationally and in Germany (Wille *et al.* 2008). Furthermore, a representative norm sample for Germany exists from the KiGGS study (Ravens-Sieberer *et al.* 2008). The KiGGS study is a German national representative study performed in the years 2003-2006 determining health status and health behaviour of children (Kurth *et al.* 2008). The KINDL® is a short generic instrument and measures the six dimensions physical well-being, emotional well-being, self-esteem, family, friends and everyday functioning (school) with a total of 24 items. The KINDL® adiposity specific disease module was additionally included in the parent's questionnaires as well as in adolescent's questionnaires.

Understanding which parts of the interventions work and which fail will help to improve the lifestyle intervention. For this purpose the kinds of health behaviour was determined as secondary outcome, which are aimed to be changed by the lifestyle intervention. Therefore, we decided to measure dietary, eating, exercise, and sedentary behaviour. Three-day weighed dietary records were used for the evaluation of dietary intake, which

are the best available accurate measurements (Kersting *et al.* 2005). Furthermore, a representative healthy German cohort was also measured by this method in the DONALD study (Sichert-Hellert *et al.* 2001). The DONALD study is an ongoing representative study analyzing the dietary habits of healthy German children (Sichert-Hellert *et al.* 2001).

Eating behaviour was assessed by self-report in adolescents by an adapted version of the FEV questionnaire (Westenhoefer & Pudel 21989) which is a German version of the Three-Factor-Eating-Questionnaire (Stunkard & Messick 1985). We used this questionnaire since this instrument was evaluated in German children and is used in several studies regarding childhood obesity in Germany (Hoffmeister *et al.* 2010). Only the two dimensions dietary restraint and disinhibition were included. Additionally, we measured the habit strength of eating sweets as well as fruits and vegetables by the Self-Report Habit Index (SRHI) (Verplanken & Orbell 2003) since habit reflects more the stability of eating behaviour than the actual amount of consumed foods. To entrench positive eating habits on the long run is a central goal of nutrition interventions.

Physical activity and sedentary time were measured by components from different instruments to obtain a comprehensive picture of these complex behaviours. Vigorous physical activity was determined by a semi-quantitative questionnaire evaluated in German children in the representative KIGGS study (Lampert *et al.* 2007a;Kurth *et al.* 2008). This questionnaire measures the frequency of vigorous physical activity not including school sport and exercise training as part of the intervention. The scales were 1=never, 2=once up to twice per month, 3=once up to twice per week, 4=three- up to five- times per week, 5= every day). Additionally parts of the Karlsruhe Activity questionnaire (KAF) (Bös *et al.* 2010) were used to measure different every day activities (e.g. transportation to school). This questionnaire was also used in the representative KIGGS- study (Kurth *et al.* 2008). Additionally, the habit strength of exercise was measured by the SRHI (Verplanken & Orbell 2003).

Since the measurement of the exact quantity of physical activity by self-report is limited, especially in children (Sallis & Saelens 2000), physical activity measurement was complemented objectively in a sub-sample of children by accelerometers (StepWatch Activity Monitor™) for 7 consecutive days before and after the intervention.

Sedentary time was determined by a questionnaire for children concerning the time for television and computer use and other sedentary activities per week (Lampert *et al.* 2007b), Again, this evaluated questionnaire was also integrated in the German representative

KIGGS study (Lampert *et al.* 2007b;Kurth *et al.* 2008). In addition the SRHI for watching TV was employed (Verplanken & Orbell 2003).

A final secondary aim was to identify prognostic factors for the effect of the lifestyle intervention. Identifying which children will profit from this kind of intervention will help to develop tailored interventions. Socio-economic status (SES), ethnicity, and parent BMI are known influencing factor on the effectiveness of lifestyle interventions in obese children (www.a-g-a.de/Leitlinie.pdf 2011;Oude *et al.* 2009). Therefore, we measured SES of the family by determining the Winkler-index developed for German health surveys (Lange *et al.* 2007) according to the representative KIGGS study (Kurth *et al.* 2008). This multidimensional index considers parents' education, occupational state, and household income and is separated into 3 groups (low, medium and high). The higher score of mother and father was used per household. Children whose parents were both immigrated or of non-German citizenship and those who were immigrated themselves and simultaneously had at least one parent of non-German origin were classified as ethnic minorities. All other boys and girls were classified as non-migrants (Schenk *et al.* 2007). Weight and height of parents and siblings were self-reported by the parents and their BMI was calculated.

Study protocol

All variables have to be assessed at baseline and the end of intervention or waiting period. Since overweight is a chronic disorder all variables have to be measured not only at the end of intervention but also at one year follow-up after the end of intervention. To have a conservative estimation of the treatment effect we decided to follow an intention-to-treat analysis approach setting all missing values at follow-up due to drop-out back to baseline values.

Sample size calculation for evaluation study

Based on a preceding phase-II feasibility cross-over trial in 19 overweight children (at baseline 10.7 ±2.1 years, 68% female, mean BMI-SDS 1.58 ±0.19, mean BMI 22.6 ±1.8 kg/m²) the required sample size for the RCT was estimated (Reinehr *et al.* 2010c). The 19 overweight children in the pilot study increased their degree of overweight significantly in the six-months waiting period before intervention (mean increase of BMI-SDS 0.15 ±0.19 and mean increase of BMI 1.1 ±0.9 kg/m²). In the following six-month intervention period, by contrast BMI-SDS (mean change -0.45 ±0.21) and BMI (mean change -1.7 ±0.9 kg/m²) decreased significantly ($p<0.001$). Based on these results and to get a conservative sample size estimate, the mean difference was reduced by 50% and the standard deviation was

increased by 50% yielding 0.225 as group-difference in BMI-SDS change and 0.315 for its standard deviation. On an alpha=0.05 level, two sided tests, a control to intervention ratio of 1 and 80% power a sample size of 64 (32 per group) was estimated for this study.

Ethical Approval

The local ethics committee of the University of Bremen approved this study. Written informed consent is obtained from all subjects and their parents prior to study start.

Results

Preliminary findings of the intervention "Obeldicks light"

Our first preliminary findings may point towards an effectiveness of the new lifestyle intervention "Obeldicks light" for overweight children and adolescents as well as towards the usefulness of our study protocol and the accurateness of our study sample estimation (Reinehr *et al.* 2010c): Our intervention and evaluation protocol was suitable for the participants of the study as demonstrated by a very low drop-out rate (3% in intervention and 16% in the control group). Furthermore, we have demonstrated in a previous study that our study population did not differ from a general population in Germany concerning social status or ethnicity (Finne *et al.* 2009) also supporting the generalizability of our results and demonstrating that all social classes were addressed by our intervention. BMI-SDS changes were significantly different across the control and intervention group. In the control group (n=32), BMI increased significantly, while BMI-SDS did not change significantly. In contrast in the intervention group (n=34), BMI and BMI-SDS decreased significantly. The success rate defined by reduction of BMI-SDS was 94% in the intervention group. Given the observed values of the difference and standard deviations of BMI-SDS change the power of this study was >0.999 at a random error level of 0.05 (Reinehr *et al.* 2010c).

Since the intervention was offered at two different treatment centres, which did not differ in the outcomes of their patients, this finding supports the generalizability of our intervention.

The reduction of overweight was independent of age and gender of the children (Reinehr *et al.* 2010c) assuming that the materials and methods of the intervention "Obeldicks light" are applicable to boys and girls in the age range of 8 to 16 years.

The achieved reduction of overweight was clinically relevant as demonstrated by a reduction of fat mass both in bioimpedance analyses and skinfold thickness measurements

(Reinehr *et al.* 2010c). Additionally, waist circumference was reduced significantly only in the intervention group (Reinehr *et al.* 2010c). Furthermore, blood pressure decreased significantly in the intervention group (Reinehr *et al.* 2010c).

A previous study suggests that the reduction of overweight achieved in our lifestyle intervention “Obeldicks light” seems to be caused primarily by changes of dietary patterns (Reinehr *et al.* 2010c): The lifestyle intervention was associated with an improvement of dietary patterns (significant reduction of energy (kcal/day), fat and sugar consumption) in the intervention but not in the control group. However, the control and intervention groups did not differ in their sports activities and sedentary behaviour suggesting that the intervention failed to decrease TV and computer consumption, which is one of the most important goal in lifestyle interventions of overweight children (www.a-g-a.de/Leitlinie.pdf 2011;Oude *et al.* 2009).

A challenge of our study was the recruitment process in spite of using multiple advertising strategies such as newspaper, television, broadcasting, school events, distribution of leaflets, and information of family doctors (Finne *et al.* 2009). Although more than 200 families presented for participation during the first 6 months of the recruitment period of the evaluation study, this process resulted primarily in the enrolment of obese children, indicating that in the search for overweight children, predominantly obese children felt addressed and the subjective need for lifestyle intervention for overweight children seems to be low (Finne *et al.* 2009).

Conclusions

This paper describes the development of a lifestyle intervention for overweight children as well as its evaluation design. Our findings will probably help to implement other lifestyle interventions in different regions.

Our evaluation protocol was suitable for the participants of study as demonstrated by a very low drop-out rate and addressing all social classes. However, our study protocol has a few important potential limitations. Since physical activity training, behaviour counselling, and nutritional education were performed simultaneously in the intervention group, we cannot distinguish the impact of each of them on overweight reduction. Furthermore, the effects of dieting and increased physical activity probably strengthened each other. Self-reported data were used to measure dietary habits and physical activity and it can be questioned as to what extent they reflect the real habits. Underreporting is a well-known

phenomenon in overweight and obese subjects (Ebbeling *et al.* 2002). Therefore, conclusions based on self-reported data such as dietary records and questionnaires have to be drawn very cautiously. However, objective measurements such as accelerometry will help us to interpret the findings.

Reducing the treatment intensity of well-established lifestyle interventions for obese children was a simple way to develop a lifestyle intervention for overweight children. The advantages are that the methods to achieve a change of lifestyle habits are well-established as well as the therapists are familiar with the implementation (as they are already experienced in “Obeldicks” training).

The achieved reduction of overweight at the end of the lifestyle intervention “Obeldicks light” was comparable to effects of lifestyle intervention in obese children (Reinehr *et al.* 2010b;Oude *et al.* 2009). This finding seems remarkable since only 50% of the physical activity lessons as well as time- and cost-intensive individual counselling were used in “Obeldicks light” as compared to the lifestyle intervention “Obeldicks” for obese children. Furthermore, the success rate in our study was much higher as compared to these studies in obese children using much more intensive interventions suggesting that an early intervention in overweight, but not obese children is preferable.

However, for the final conclusion of an effectiveness of our new lifestyle intervention “Obeldicks light”, we have to wait for the end of the follow-up study to prove whether the achieved weight loss was sustained. Furthermore, ongoing studies analyzing the changes of quality of life will help us to verify that the achieved weight reduction is also relevant for the patients. Additionally, identification of predictive factors for success in ongoing studies will help to determine which children will have the greatest profit of this kind of intervention probably influencing our inclusion criteria.

Conflict of interest:

All authors have no conflict of interest

Acknowledgements

AS, TR and KW developed the lifestyle intervention, TR, EF and PK performed the evaluation study, AS, KW, EF, PK and TR performed the discussion, TR wrote the first version of the manuscript

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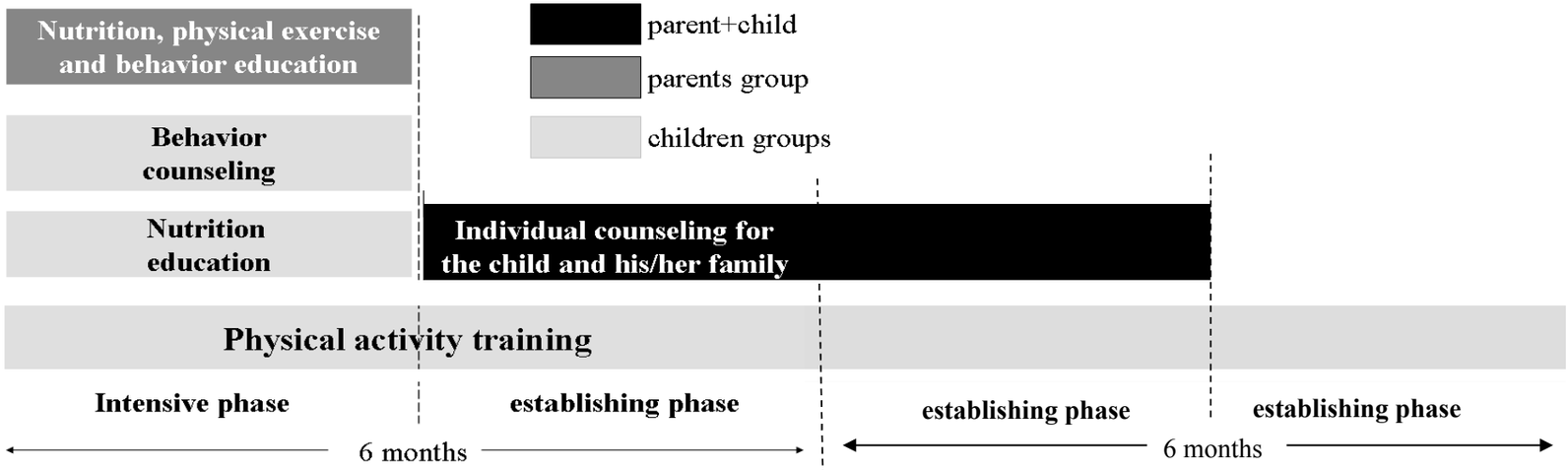
Table 1: Design of the evaluation study

- Design: Randomized controlled trial with intention-to treat analyses and measurements at
  - baseline,
  - end of intervention or end of waiting period, and
  - 1 year after end of intervention
- Measurements:
  - Primary outcome: change of BMI-SDS
  - Secondary outcome:
    - change of body composition (bioimpedence analysis, skinfold measurements)
    - change of cardiovascular risk factors (waist circumference, blood pressure)
    - change of quality of life (questionnaire (Ravens-Sieberer *et al.* 2008))
    - change of health behaviour
      - three-day-weighed dietary records
      - eating habits (questionnaire (Verplanken & Orbell 2003;Westenhoefer & Pudel 21989))
      - exercise habits (questionnaire (Verplanken & Orbell 2003;Lampert *et al.* 2007a;Lampert *et al.* 2007b;Bös *et al.* 2010))
      - sedentary behaviour (questionnaire (Verplanken & Orbell 2003))
      - accelerometer measurements
    - predictive factors:

- parental BMI, ethnicity, socioeconomic status (Lange *et al.* 2007)

Figure 1: Structure of the lifestyle intervention “Obeldicks” for obese children and “Obeldicks light” for overweight children, the dashed vertical line divided the intervention period into two 3-month subunits

outpatient lifestyle intervention „Obeldicks“ for obese children



outpatient lifestyle intervention „Obeldicks light“ for overweight children