

## Regular Article

Psychotherapy  
and PsychosomaticsPsychother Psychosom 2008;77:235–246  
DOI: [10.1159/000129659](https://doi.org/10.1159/000129659)

Published online: April 28, 2008

# Randomized Controlled Comparison of Two Cognitive Behavioral Therapies for Obese Children: Mother versus Mother-Child Cognitive Behavioral Therapy

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## Key Words

Childhood obesity · Parent involvement · Cognitive behavioral treatment · Randomized controlled trial

## Abstract

**Background:** Parent-child treatments have been shown to be superior to child-focused treatments of childhood obesity. Yet until now, the comparative effectiveness of parent-only and parent-child approaches has been little studied.**Method:** Fifty-six obese children and their families were randomly assigned to a 16-session cognitive behavioral therapy (CBT) for the parents only or for a combined treatment of parents and children. Children's percent overweight, the body mass index of their mothers, and behavioral and psychological problems of children and mothers were assessed.**Results:** Both treatments reduced children's percent overweight significantly and equally by 6-month follow-up. Also both treatments provided similar results in reducing general behavior problems (externalizing and internalizing behavior problems), global and social anxiety, and depression. **Conclusions:** Our results point to a comparable efficacy of the two treatments. Further, psychological well-being of both

mothers and children can be improved in a CBT for obese children and their parents. Future studies should focus on finding ways to improve the adherence of families to long-term treatment of obesity in childhood.

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The prevalence of overweight and obesity among children aged 6–11 years has more than tripled in the United States in recent years, rising from 4% in 1971–1974 (National Health and Nutrition Examination Survey) to 16% in 1999–2002 [1]. Childhood obesity is also becoming more common in Western Europe [2–5]. Besides the various health consequences of childhood obesity [6], many obese children suffer from behavioral problems or mental disorders [7–15].

Nowadays, biological, psychological, and psychosocial factors are associated with the development and maintenance of obesity [16–19]. In children, the model behavior of the family plays an important role in the development of obesity [20–24]. Clinical research in childhood obesity has reported short- and long-term superiority of parent involvement in treatment compared to the treatment of

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the child alone [25–30]. It is suggested that parents should be the main agents of change [31–33]; but to conclude that the exclusive treatment of parents is the treatment of choice would be premature, as there is limited data on the comparative effectiveness of parent-exclusive and parent-child approaches (the latter being where parents and children are treated simultaneously but separately) [33].

In the current study, we investigated whether the treatment of parents only would be as efficacious as a parent-child treatment in a randomized controlled clinical trial. Our group treatment approach, TAKE [*Training adipöser Kinder und deren Eltern* ('training of obese children and their parents')], targeted weight stabilization and reduction of behavioral problems of obese children aged 8–12 years [34–36]. We further sought to expand on prior research and investigated psychological variables during the treatment course using valid instruments and accounted for methodological considerations by providing detailed information about treatment content, therapists, compliance, ratings of suitability and treatment integrity.

## Method

### Participants

The study was conducted at the Department of Clinical Psychology and Psychotherapy of the University of Basel and at the Children's and Adolescents' Psychiatry Outpatient Clinic in Bruderholz (Switzerland). Study inclusion criteria required children to be between 8 and 12 years old with a body mass index (BMI) above the 85th percentile adjusted for gender and age.

Participating family members were able to speak and write in German. Parents and children meeting the criteria of the DSM-IV-TR [37] for mental disorders warranting immediate treatment (assessed in a clinical interview), such as suicidal tendency, psychosis, mania, organic dementia, or substance abuse disorder, were excluded from the study. All participants were free from diabetes, heart disease, and endocrine disorders. Further exclusion criteria were parents' or children's participation in a diet program or other psychotherapy treatment with weight loss medication. As there were only 4 fathers eligible for treatment, we excluded fathers' data from the analyses. For a diagram of the participant flow see figure 1.

The Swiss National Foundation funded the study for a period of about 2 years. Although we made extensive recruitment efforts through different media, recruitment turned out to be difficult and we did not reach the necessary sample size of 68 families with obese children within the given time span (the target sample size of 68 was based on a repeated-measures analysis with  $\alpha = 0.05$ ,  $1 - \beta = 0.8$ , and a medium effect size for the linear term of the interaction between treatment and time, assuming a dropout rate of 20% [38]; note that all subjects who dropped out of the study would be completely eliminated from the analysis. At the time of the analysis of the data we therefore decided to use linear mixed models; see below).

The local Ethics Committee Board of Basel approved the protocol. Families signed up for a study entitled 'Treatment for obese children and their parents' and gave written informed consent at the initial Institute visit.

### Study Design

After screening, families were randomly assigned according to a permuted block design to either the mother-child (condition A) or the mother-only (condition B) cognitive behavioral therapy (CBT) treatment [39] (fig. 1). In both conditions, mothers received CBT. Children in condition B attended a relaxation training (progressive muscle relaxation training, PMR) of equal frequency and duration to the disorder-specific CBT of children in condition A. This procedure was chosen because PMR was shown to account for possible nonspecific effects of 'attention' [40–43]. For practical and ethical reasons, we were not able to run an additional control group, such as a waiting list group. Each treatment group started whenever 6–8 families had been recruited. This recruitment scheme resulted in a slight imbalance in sample size between the two treatment conditions (fig. 1).

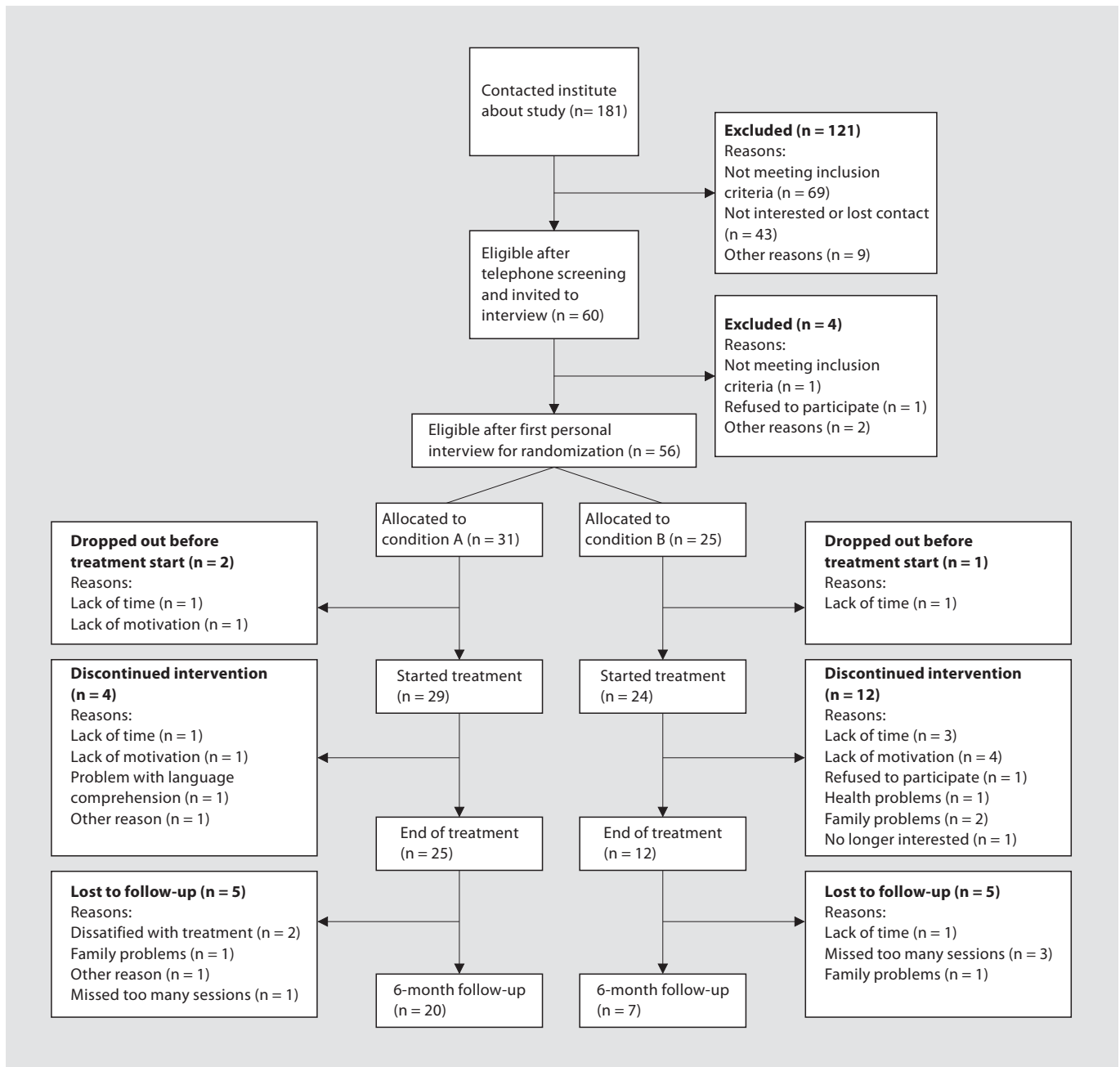
### Treatment

#### TAKE Protocol

The TAKE program was developed according to the guidelines of Barlow and Dietz [44] and Summerbell et al. [45] by Simone Munsch and Binia Roth (manual in preparation). Treatment was tailored to the specific problems in the individual mother-child dyad according to the individual-treatment-in-group approach [46].

The group sessions began with a short overview of the topic, then individual difficulties and progress with homework were discussed and the group established coping strategies. Afterwards the major topics of the sessions were implemented and new homework was assigned. Interventions throughout the program were highly interactive, proceeded step by step, and involved the group as a whole as well as individual mothers and children.

During the first 3 sessions, families were informed about the treatment protocol and about the model of etiology and maintenance of obesity in childhood. In the next 2 sessions, the basic rules of regular and balanced nutrition were introduced using the stoplight diet, which categorizes foods as low, medium, or high fat and instructs users to eat freely from the low-fat category, cautiously from the middle category, and only rarely from the high-fat foods [47]. To implement a functional eating style, mothers were encouraged to follow three basic food rules for family meals: (1) 'any food on the table may be eaten by all family members'; (2) 'offer only restricted amounts of high-fat foods', and (3) 'offer a sufficient amount of low-fat food so that the child can eat until satiated'. Sessions 4, 5 and 6 aimed at encouraging mothers to model physical activity in daily family life. Goal achievement was self-monitored daily by the children and mothers and rewarded regularly according to an individualized plan ('principle of token economies' [48]) for each mother-child dyad. In session 8, maintenance of achieved behavior change and issues of motivation were addressed. Sessions 7 and 9 focused on enabling mothers to cope with the social stigmatization of obesity for their offspring. In session 10 as well as during the 6 monthly aftercare sessions, goal achievement and relapse prevention skills were implemented. For further details about the goals and techniques of the treatment protocols of conditions A and B, see table 1.



**Fig. 1.** Participant flow. Condition A: mother-child treatment. Condition B: mother-only treatment.

#### PMR for Children

The nonspecific control condition for the children in the specialized CBT for mothers only was a PMR treatment for children, following Speck's [49] manual, in which overweight or obesity and the management of these conditions were not targeted. The treatment took place in separate but parallel groups with up to 6 children and 6–12 mothers in each group. The treatment phase consisted of 10 weekly 120-min sessions and 6 monthly sessions.

Both parent-child (condition A) and mother-only (condition B) groups were led by 6 psychotherapists with clinical experience of at least 2 years of specialized CBT education and by a cotherapist, following a standardized treatment protocol. Cotherapists were master's degree students of the University of Basel, Department of Clinical Psychology and Psychotherapy. All therapists were trained and supervised weekly by one of the authors (S.M. or B.R.).

**Table 1.** Details about the goals and techniques of the treatment protocols of conditions A and B

Treatment of mothers in mother-only CBT						
phase	session <sup>1</sup>	goals	techniques/interventions			
1 Nutrition and eating behavior	1	Understanding the etiology and treatment of childhood obesity	Psychoeducation about the etiology of childhood obesity, risks of dieting, and frequent weighing			
	2–3	Introducing regular and balanced nutrition	Nutritional counseling			
	4	Family rules for flexible eating behavior; realistic goals setting	Psychoeducation about stimulus and response prevention by controlling food access; family rules for eating behaviors			
2 Physical activity	5–6	Increasing physical activity, sports	Psychoeducation about role of physical activity in weight regulation and body concept; increasing physical activity by reinforcement (token economy); suitable sports; getting started and long-term motivation			
3 Social competences	7	Training of social skills	Training of parental skills; parental modeling and support of children being teased/bullied; dealing with difficult situations			
1 Nutrition and eating behavior	8	Maintaining balanced nutrition	Nutritional counseling			
4 Body concept	9	Supporting children's development of a positive body concept	Psychoeducation about: development and influences of a negative body concept			
5 Relapse prevention	10	Training maintenance skills	Appraisal of goal attainment; developing coping and maintenance strategies			
Follow-up treatment	1–6	Maintaining changes and problem solving	Goal achievement and new goal setting; individual problem solving			
Treatment of children in mother-child CBT (condition A)				Children's PMR (condition B) <sup>2</sup>		
phase	session <sup>1</sup>	goals	techniques/interventions	ses- sion <sup>1</sup>	goals	techniques/ interventions
1 Nutrition and eating behavior	1	Understanding the etiology and treatment of obesity	Psychoeducation about the etiology of childhood obesity, risks of dieting, introducing weekly weighing			
	2	Basic nutritional education (by psychologist)	Regular eating behavior classifying nutrients by the stoplight diet			
	3	Reinforcement and tokens	Token plan/contract for regular and healthy eating			
2 Physical activity	4–5	Increasing physical activity, sports	Embedding physical activity in everyday life; increasing motivation; reinforcement plan (token economy) for increased physical activity; weekly 1-hour sport sessions (by gym instructor)	1–10	Handling stress	PMR: exercises
<i>Lessons in physical activity (phases 3–5)</i>						
3 Social competences	6–7	Training in self-assertiveness	Self-assertiveness training with focus on social skills and saying 'no' to food offers			
	8	Training in self-assertiveness	Telling teasers off! Development of an antibullying plan, role modeling			
4 Body concept	9	Developing a positive body concept	Identifying and reinforcing positive qualities of one's own body and person			
5 Relapse prevention	10	Training maintenance skills	Developing and exercising maintenance strategies			
Follow-up treatment	1–6	Maintaining changes and problem solving	Goal achievement and new goal setting; individual problem solving	1–6	Handling stress	PMR: exercises
<sup>1</sup> Phases 1–5: sessions were weekly; follow-up: sessions were monthly. <sup>2</sup> Nonspecific treatment condition for children in the specialized CBT for mothers only.						

### Assessments

Children's sociodemographics and mental disorders were assessed at baseline. Children's percent overweight, depression [*Depressionsinventar für Kinder und Jugendliche* [50] (DIKJ)], measures of anxiety [State-Trait Anxiety Inventory for Children [51] and its German [52] version *State und Trait Angst-Inventar für Kinder* (STAIK); Social Anxiety Scale for Children-Revised (SASC-R) [53] and its German [54] version; subscales: Fear of Negative Evaluation (FNE), Social Avoidance and Distress with Peers (SAD)], and behavior problems [Child Behavior Checklist (CBCL) [55] and its German [56] version] were all assessed at the beginning and end of treatment and at the end of the 6-month follow-up.

Socioeconomic status (SES) and mental disorders in mothers were also assessed at baseline. Mothers' BMI, eating behavior [Eating Disorder Examination (EDE) [57] and its German [58] version], depressive feelings [Beck Depression Inventory (BDI) [59] and its German [60] version], anxiety measures [Beck Anxiety Inventory (BAI) [61] and its German [62] version], life satisfaction [*Fragebogen zur Lebenszufriedenheit* [63] (FLZ)] and ratings of self-efficacy were all assessed at the beginning and end of treatment and at the end of the 6-month follow-up.

The questionnaires possess good psychometric properties such as internal consistency, reliability, and convergent validity and were mailed to the families 1 week prior to the start of treatment. The children and their mothers were requested to bring the completed set of questionnaires to the first session. The questionnaires took on average about 1 h to complete. The interviews of mothers and children were held separately, in 1 session, over 1–2 h.

### BMI and Percent Overweight

Children were weighed in underwear, mothers in light clothes to the nearest 0.1 kg on a Seca electronic balance (Seca, Vogel + Halke, Germany) and height was measured without shoes to the nearest 0.1 cm with a stadiometer. BMI was calculated as weight in kilograms divided by the square of height in meters. After children were weighed and measured, the weighted BMI [percent overweight = (effective BMI/BMI 50th percentile) – 1] was calculated based on age and gender [64].

### Mental Disorders and Eating Disorder Pathology

#### Children

To assess current and lifetime mental disorders in children, the structured interview for mental disorders in childhood, *Diagnostisches Interview bei psychischen Störungen im Kindes- und Jugendalter* (K-DIPS) [65], was administered in child and parent versions. Standardized administration of the interviews was ensured by weekly supervision by two of the authors (S.M. and B.R.). Binge eating symptomatology was assessed in a screening interview, following Marcus and Kalarchian [11]. A German version was developed specifically for this study and is available from the authors.

Children's behavioral problems and competences were further assessed with the German version of the CBCL [56], a 138-item questionnaire completed by the parents. This instrument provides a standardized description of skills and emotional and behavioral problems in 4- to 18-year-old children. The first part results in 3 subscales (activities, social competences, and school competences) and a total competence score. The second part

yields 8 scales of behavior problems (withdrawal, somatic complaints, anxiety/depression, social problems, thought problems, attention problems, delinquent behavior, aggressive behavior) that are subsumed in the 2 subscales of internalizing and externalizing behavior problems, and in a total problem score.

#### Mothers

We used the German version of the EDE [58] to assess disordered eating behavior such as eating concern, shape concern, weight concern, and dietary restraint. A semi-structured interview to assess current and lifetime mental disorders [*Diagnostisches Kurzinterview bei psychischen Störungen* [66] (Mini-DIPS), screening for mental disorders] was administered by specifically trained and supervised interviewers.

### Depression and Anxiety Ratings

#### Children

All children completed questionnaires to assess depressive symptoms (Children's Depression Inventory [67]; DIKJ [50]), anxiety (STAIK [52]; SASC-R [53] and its German version [54]), SAD, and FNE.

#### Mothers

Individuals completed the German versions of the BDI [60] and the BAI [62] to measure depression and anxiety.

### Socioeconomic Status

SES was assessed by a questionnaire especially developed for the study (available from the authors). According to their occupations, families were categorized into a low (e.g. unemployed, homemaker, factory worker), medium (e.g. foreman/forewoman, master craftsman/craftswoman, self-employed in trade/industry) or high (e.g. manager, senior official) SES group.

### Integrity of Treatment

Two independent raters (students of clinical psychology holding a bachelor's degree) separately judged adherence to treatment protocol. Eight randomly selected videotaped sessions of conditions A and B were coded with a session-dependent 25- to 34-item (child sessions) or a 15- to 18-item (parent sessions) questionnaire especially developed for the study (unpublished data, available from the authors). Neither rater acted as a therapist or cotherapist in the treatment trial. Raters were blinded to which session and which therapy condition they were rating. The rating included treatment-specific questions such as 'Was the importance of regular eating behavior explained comprehensibly?' and 'Were the interventions tailored to the specific familial setting?' for the CBT of the mothers in either condition A or B and 'Was the effect of PMR discussed with all participants?' for the children of the mothers in condition B.

### Suitability of Treatment

Suitability ratings of treatment of mothers were assessed with an item from the session protocol of Grawe et al. [68] (item 19: 'I think another therapeutic procedure would be more suitable for me') that was administered on a 7-point Likert scale from –3 ('not at all') to +3 ('yes, exactly'). Ratings were assessed in the middle and at the end of the series of weekly treatments and at the 6-month follow-up.

**Table 2.** Sample characteristics of children

	Study group				Test statistic and significance
	mother-child CBT		CBT for mothers only		
Female	17 (58.6)		15 (62.5)		$\chi^2 = 0.83$ ; $p = 0.77$
Male	12 (41.4)		9 (37.5)		
Age (mean $\pm$ SD), years	10.3 $\pm$ 1.4	n = 28	10.6 $\pm$ 1.5	n = 21	$t_{41} = -0.59$ ; $p = 0.56$
Percent overweight (mean $\pm$ SD)	55.4 $\pm$ 17.9	n = 28	62.4 $\pm$ 27.2	n = 21	$t_{33} = -1.03$ ; $p = 0.31$
BMI (mean $\pm$ SD)	26.5 $\pm$ 3.3	n = 28	28.0 $\pm$ 5.4	n = 21	$t_{31} = -1.15$ ; $p = 0.26$
Age of onset of obesity (mean $\pm$ SD), years	5.2 $\pm$ 2.4	n = 27	5.1 $\pm$ 3.0	n = 23	$t_{42} = 0.78$ ; $p = 0.94$
BED diagnosis <sup>a</sup>	6 (20.7)	n = 26	9 (37.5)	n = 23	$\chi^2 = 1.48$ ; $p = 0.22$
Mental disorders <sup>b</sup>	10 <sup>c</sup> (34.5)		8 <sup>d</sup> (33.3)		$\chi^2 = 0.01$ ; $p = 0.93$

BED = Binge eating disorder. Figures in parentheses indicate percentages.

<sup>a</sup> Diagnosis criteria by Marcus and Kalarchian [11]. <sup>b</sup> Kinder-DIPS [65]. <sup>c</sup> Attention deficit hyperactivity disorders (n = 4), social phobias (n = 3), oppositional defiant disorders (n = 2), obsessive-compulsive disorder (n = 1). <sup>d</sup> Attention deficit hyperactivity disorders (n = 2), oppositional defiant disorders (n = 2), major depression (n = 1), dysthymia (n = 1), social phobia (n = 1), specific phobia (n = 1).

### Statistical Analysis

To compare sample characteristics between treatments we used t tests for independent samples for continuously distributed variables and  $\chi^2$  tests for categorical variables. Differences between the two treatments in suitability of treatment, compliance, and treatment integrity were all tested using t tests for independent samples. To measure treatment integrity we calculated the gamma coefficient. Differences in dropout rates between the two treatments were tested using the  $\chi^2$  test.

The primary outcome variables were percent overweight for children and BMI for mothers. Secondary outcomes included measures of behavior problems (CBCL scores), anxiety, and depression in children, and eating behavior (EDE global score), anxiety, and depression in mothers.

To compare the two treatment modalities from baseline to 6-month follow-up we used linear mixed models. In studies where missing values frequently occur and if the absence only depends on observed and not on unobserved measurements (a so-called missing-at-random pattern [69]), linear mixed models have been shown to lead to more precise and less biased results compared with complete case analyses or analyses in which missing values have been imputed prior to the analysis using the last-observation-carried-forward (LOCF) method. Also, results based on the LOCF method can be biased in either direction and thus can be interpreted as being conservative or liberal [70]. In linear mixed models, participants with missing data are not omitted from the analysis, in contrast to the split-plot repeated-measures approach that requires complete cases for each time point and participant. Our model allowed us to test for the effect of temporal changes averaged across the two treatments, for the difference between the two treatments averaged across all assessment points, and, most importantly, for temporal changes between the two treatments (time  $\times$  treatment interaction).

The factor time consists of a linear and a quadratic component. The linear component tests for a positive or negative linear trend over time, whereas the quadratic component tests for a cur-

vilinear trend over time, such as a temporal decline followed by no changes or an increase. Note that in the presence of a quadratic component the linear component is not constant but represents the instantaneous rate of change at a particular time point (here: end of treatment). This is particularly important if the quadratic component is high, pointing to a time trajectory that strongly deviates from linearity. When reporting results, we will concentrate on the two main contrasts 'linear time trend' and 'quadratic time trend' and on the two interactions 'linear time trend  $\times$  treatment' and 'quadratic time trend  $\times$  treatment'.

The number of assessment points varies across the different outcomes. The linear mixed model we used allowed the intercepts and slopes to vary randomly among the individuals, leading to an implicit covariance structure. Parameter estimates were obtained using the restricted maximum likelihood method. All data were analyzed using the software packages R [71] and SPSS, version 12 [72].

### Results

Sample characteristics of children and mothers are shown in tables 2 and 3. Mothers in the parent-child treatment rated the suitability of treatment (mean = -1.14, SD = 1.21) similarly to participants in the parent-exclusive treatment (mean = -1.31, SD = 1.03) after the first session, where treatment rationales were introduced ( $t_{18} = 0.32$ ,  $p = 0.75$ ). In both treatment modalities, suitability ratings remained stable until post-treatment (parent-child CBT: mean = -1.1, SD = 1.66; specialized CBT for mothers only: mean = -1.25, SD = 1.04,  $t_{16} = 0.22$ ,  $p = 0.83$ ). At 6-month follow-up, suitability ratings were maintained and again did not differ between groups (par-

**Table 3.** Sample characteristics of mothers

	Study groups		Test statistic and significance
	mother-child CBT	CBT for mothers only	
Sample size	29	25	
Age (mean $\pm$ SD), years	40.9 $\pm$ 4.4	38.8 $\pm$ 6.0	$t_{43} = 1.47$ ; $p = 0.15$
BMI (mean $\pm$ SD)	29.6 $\pm$ 7.5	26.9 $\pm$ 3.9	$t_{31} = 1.44$ ; $p = 0.16$
Mental disorders <sup>a</sup>	8 <sup>b</sup> (29.6)	6 <sup>c</sup> (25.0)	$\chi^2 = 0.14$ ; $p = 0.71$
Low/medium/high SES category	11/15/2 (39.3/53.6/7.1)	13/11/2 (50.0/42.3/7.7)	$\chi^2 = 0.71$ ; $p = 0.70$

Figures in parentheses indicate percentages.

<sup>a</sup> Mini-DIPS [66]. <sup>b</sup> Specific phobias (n = 3), major depression (n = 3), panic disorder (n = 1), social phobia (n = 1). <sup>c</sup> Specific phobias (n = 3), social phobia (n = 1), generalized anxiety disorder (n = 1), posttraumatic stress disorder (n = 1).

ent-child CBT: mean = -1.2, SD = 1.70; specialized CBT for mothers only: mean = -1.88, SD = 0.99,  $t_{21} = 1.20$ ,  $p = 0.68$ ).

Nonspecific treatment indices ensured that quality and competences of therapists were equal in the two conditions. As mothers in the two treatment modalities received equal treatment, the treatment integrity ratings of parents revealed no differences between treatment-specific ( $t_{14} = -0.35$ ,  $p = 0.73$ , gamma for interrater reliability = 0.62) and nonspecific ( $t_{14} = 0.48$ ,  $p = 0.64$ , gamma for interrater reliability = 0.29) indices. Ratings of children's sessions indicated that the treatment-specific indices significantly differed between the treatments ( $t_7 = 9.86$ ,  $p < 0.001$  for the children's CBT-specific index, and  $t_8 = -13.15$ ,  $p < 0.001$  for the children's PMR-specific index), being higher for the CBT as expected, whereas the nonspecific contents were comparable in both treatments ( $t_{14} = 1.58$ ,  $p = 0.14$ ). Interrater reliability was satisfactory with a gamma coefficient of 0.98 ( $p < 0.001$ ) for specific indices and 0.94 ( $p < 0.001$ ) for nonspecific indices.

Children in the parent-child CBT attended slightly more of the 10 sessions (9.00, SD = 1.00) than those in the specialized CBT for mothers only (7.75, SD = 2.01;  $t_{13.7} = 2.04$ ,  $p = 0.06$ ). During follow-up, there was no difference in attendance of the 6 sessions between treatment conditions (mother-child CBT: 3.90, SD = 1.55, 65.0%; specialized CBT for mothers only: 4.0, SD = 1.16, 66.6%;  $t_{14.2} = 0.18$ ,  $p = 0.88$ ). The dropout rates between baseline and 6-month follow-up were 9 (31.0%) and 17 (70.8%) in the parent-child CBT and the specialized CBT for mothers only, respectively, and these proportions were significantly different from each other ( $\chi^2 = 8.3$ ,  $p = 0.004$ ).

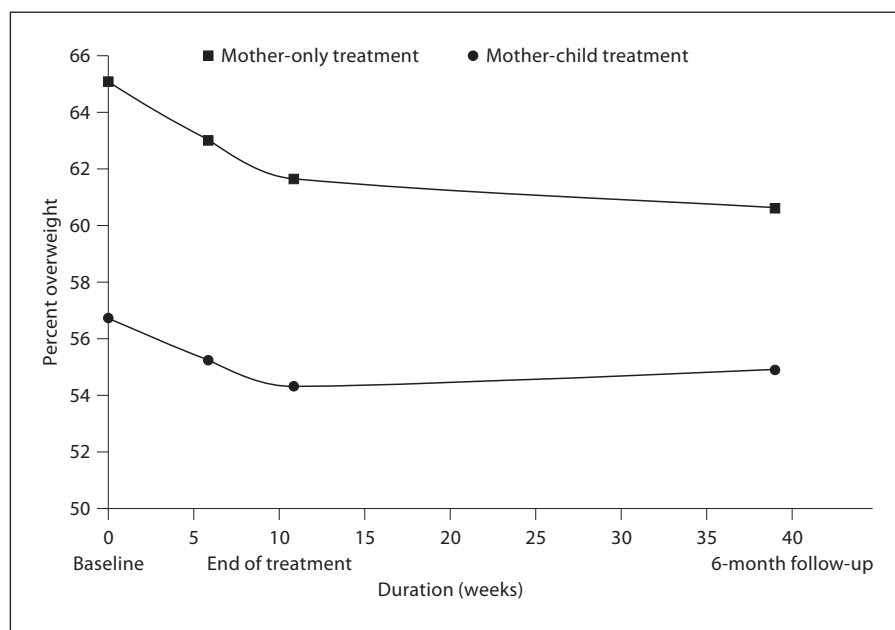
We further tested whether the probability of a family withdrawing from treatment was related to the following

measures: sex, age, BMI, depression (BDI, DIKJ), anxiety (BAI, STAIK-T), comorbid mental disorders of children and mothers, or EDE global score of mothers using  $t$  tests (for continuously distributed variables) or Fisher's exact tests/ $\chi^2$  tests (for categorical variables). None of the comparisons between withdrawers and completers reached statistical significance for any of these variables ( $p > 0.05$  for all comparisons) except that younger mothers were more likely to be missing at 6-month follow-up than older mothers ( $p = 0.008$ ).

#### Primary Outcomes

Children in both treatment modalities reduced their percent overweight between baseline and 6-month follow-up ( $p < 0.001$  for linear trend). This reduction was faster early in the treatment phase and slower thereafter ( $p = 0.002$  for quadratic trend). The temporal courses of the two treatments, however, did not differ ( $p = 0.43$  for interaction linear trend  $\times$  treatment,  $p = 0.83$  for interaction quadratic trend  $\times$  treatment; fig. 2). Estimated means from the linear mixed model are shown in table 4. Effect sizes (Cohen's  $d$ ) for percent overweight between the two treatments were 0.32 and 0.29 at the end of treatment and at 6-month follow-up, respectively.

There were no changes in mothers' BMI between baseline and 6-month follow-up ( $p = 0.76$  for linear time trend,  $p = 0.85$  for quadratic trend) and the temporal course was not influenced by treatment modalities ( $p = 0.77$  for interaction linear trend  $\times$  treatment,  $p = 0.48$  for interaction quadratic trend  $\times$  treatment, see also table 5). Effect sizes for mothers' BMI between the two treatments were 0.37 and 0.44 at the end of treatment and at 6-month follow-up, respectively.



**Fig. 2.** Course of children's percent overweight (values denote estimated marginal means from a linear mixed model).

**Table 4.** Primary and secondary outcomes of children at baseline, end of treatment, and end of follow-up

Variable	Baseline				End of treatment				End of follow-up			
	mother-child CBT		CBT for mothers only		mother-child CBT		CBT for mothers only		mother-child CBT		CBT for mothers only	
	mean	SE	mean	SE	mean	SE	mean	SE	mean	SE	mean	SE
Percent overweight	56.76	6.12	65.09	6.12	54.29	6.46	61.59	6.46	54.85	7.64	60.57	7.64
DIKJ total score	2.32	0.31	2.48	0.31	1.23	0.45	1.88	0.45	1.66	0.54	1.79	0.54
STAIK-T total score	3.37	0.06	3.33	0.06	3.14	0.07	3.18	0.07	3.19	0.09	3.25	0.09
SASC-R SAD	4.26	0.17	3.98	0.17	3.72	0.19	3.61	0.19	3.65	0.24	3.56	0.24
SASC-R FNE	2.89	0.11	2.91	0.11	2.62	0.13	2.57	0.13	2.49	0.16	2.86	0.16
CBCL global score	4.51	0.54	5.31	0.54	3.78	0.59	4.18	0.59	4.27	0.73	4.63	0.73

Means denote estimates from a linear mixed model. Standard errors of differences between the two group means (SE) are shown, including error probability (p), which allows testing for significant differences between the two treatment values at the given time points, based on a t test for independent samples.

### Secondary Outcomes

For the secondary outcomes in children, we found significant linear decreases between baseline and 6-month follow-up for depressive feelings and for all anxiety measures ( $p < 0.001$  for linear trend in variables SAD, DIKJ, FNE, STAIK, and CBCL total score). In all these cases, a quadratic polynomial significantly improved the model fit ( $p \leq 0.005$  for linear and quadratic trends in all five variables). Thus, the trends observed for these variables during the treatment phase were either decelerated (SAD)

or slightly reversed (DIKJ, FNE, STAIK, and CBCL total score) toward the 6-month follow-up (table 4). The temporal course did not vary across the two treatments ( $p > 0.1$  for all secondary outcomes and for both interactions, linear trend  $\times$  treatment and quadratic trend  $\times$  treatment). Estimated means based on the linear mixed model showed that only the FNE at 6-month follow-up differed between the two treatments with lower values for the mother-child treatment compared to the specialized CBT for the mothers (table 4).



**Table 5.** Primary and secondary outcomes of mothers at baseline, end of treatment, and end of follow-up

Variable	Baseline				End of treatment				End of follow-up			
	mother-child CBT		CBT for mothers only		mother-child CBT		CBT for mothers only		mother-child CBT		CBT for mothers only	
	mean	mean	SE	p	mean	mean	SE	p	mean	mean	SE	p
BMI	29.64	27.34	1.69	0.17	29.60	27.40	1.69	0.19	29.70	27.21	1.70	0.15
BDI	1.95	2.10	0.31	0.64	1.61	1.01	0.42	0.16	1.57	1.15	0.55	0.47
BAI	1.20	1.52	0.29	0.28	1.04	1.05	0.29	0.97	1.07	0.68	0.40	0.36

Means denote estimates from a linear mixed model. Standard errors of differences between the two group means (SE) are shown, including error probability (p), which allows testing for significant differences between the two treatment values at the given time points, based on a t test for independent samples.

Mothers' secondary outcomes revealed a significant interaction between time and treatment modality for the BDI. Whereas in the mother-child CBT results for the BDI only moderately decreased throughout the study, in the specialized CBT for the mother only, these values strongly decreased, especially early in the treatment phase ( $p = 0.033$  for interaction quadratic trend  $\times$  treatment). Results for the BAI were similar but less pronounced than for the BDI. BAI values in the CBT for mothers only tended to decrease until the 6-month follow-up ( $p = 0.097$  for interaction linear trend  $\times$  treatment). Estimated means are shown in table 5.

## Discussion

The main goal of our study was to compare the efficacy of a specialized CBT for parents only to a specialized parent-child treatment with respect to the reduction of children's percent overweight and psychological parameters. Our study results show that both treatments were efficacious with respect to the reduction of overweight in children between baseline and 6-month follow-up and that these reductions were similar between the two treatments. During treatment, anxious and depressive feelings in both children and mothers and overall behavior problems in children were significantly improved and maintained until follow-up. As depressive symptoms might be a valuable predictor for adolescent and adult obesity [73], future studies should investigate whether a lasting improvement in psychological parameters is associated with better long-term maintenance of weight reduction.

The overweight reduction in our study was less pronounced than in comparable treatment studies [10, 27, 28,

31–33, 74, 75]. However, it should be kept in mind that our results are based on linear mixed models whereas other authors often performed completer analyses [31, 32, 75], which can lead to biased results [70]. For example in our study, percent overweight between baseline and 6-month follow-up was reduced by 1.9 (mother-child CBT) and 4.5 (mother-only CBT) percentage points based on a linear mixed model. Corresponding values are  $-1.0$  (mother-child CBT) and  $-7.1$  (mother-only CBT) percentage points based on a completer analysis using a split-plot repeated-measures design and  $-1.9$  (mother-child CBT) and  $-2.8$  (mother-only CBT) percentage points based on an intent-to-treat analysis (LOCF method). Other explanations for the smaller weight reduction rate in our sample might be the lower frequency of sessions [11, 31, 32, 75–77] or the high rates of comorbid mental disorders that might have influenced treatment outcome negatively.

Several concerns have to be addressed when discussing our results. As our randomization procedure resulted in an unequal number of groups of each treatment modality we could not control for seasonal effects on weight course for one group [78, 79]. We further had to exclude fathers from our analyses; hence we can only draw conclusions about the role of the mothers in treatment of obese children. Another limitation concerns the lack of information about physical activity or eating behavior of the children during the study course, although these were major topics of the treatment. Further, the follow-up period of 6 months does not satisfy the criteria of evaluating long-term efficacy as obese individuals are known to compensate for their weight loss [80]. The major limitations of this study are the small sample size and the high dropout rates, which exceed those for parent-exclusive treatments mentioned in the literature [81]. Although we undertook intensive efforts to recruit families over a

2-year period, we did not succeed in reaching a sample size that would allow us to detect a moderate effect size. During the recruitment we often encountered the phenomenon of parents not recognizing their child's health risk from being overweight or obese [82–84]. Moore et al. [85] suggested, and we agree, that training of the research staff should be incorporated into the study design, to enhance the quality of the recruitment efforts. Judging by our clinical experience, one reason for the overall high dropout rates may be that many mothers, busy with family life and career, were overwhelmed by the effort needed to sustain long-term lifestyle changes and weight stabilization in their children. By the end of follow-up, considerably more families had withdrawn from the specialized CBT for mothers only than from the mother-child treatment. There are two possible explanations for this finding. First, the PMR condition might have disappointed and discouraged the children [86]. Second, the lack of ad-

herence in this group might reflect difficulties mothers had in taking over the sole responsibility for initiating and maintaining behavior change. We conclude that there is a need for future research to enhance mothers' motivation to foster long-term behavior change in obese children.

### Acknowledgement

The treatment trial was funded by the Swiss National Science Foundation (SNF; 3251-067078.01), which supports research projects of general interest to the Swiss public. The SNF approved the initial study design and is informed yearly about the progress of the ongoing study but does not intervene with the scientific content or results. Publication of the results is done independently of the SNF. The principal investigator (S.M.) had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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