

University of Groningen

## Effect of a multidisciplinary treatment program on eating behavior in overweight and obese preschool children

Bocca, Gianni ; Kuitert, Mirije; Sauer, Pieter J J; Corpeleijn, Eefje

*Published in:*  
Journal of pediatric endocrinology & metabolism

*DOI:*  
[10.1515/jpem-2017-0390](https://doi.org/10.1515/jpem-2017-0390)

**IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.**

*Document Version*  
Publisher's PDF, also known as Version of record

*Publication date:*  
2018

[Link to publication in University of Groningen/UMCG research database](#)

*Citation for published version (APA):*

Bocca, G., Kuitert, M. W. B., Sauer, P. J. J., & Corpeleijn, E. (2018). Effect of a multidisciplinary treatment program on eating behavior in overweight and obese preschool children. *Journal of pediatric endocrinology & metabolism*, 31(5), 507-513. DOI: 10.1515/jpem-2017-0390

**Copyright**

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

**Take-down policy**

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

*Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.*

Gianni Bocca\*, Mirije W.B. Kuitert, Pieter J.J. Sauer and Eva Corpeleijn

# Effect of a multidisciplinary treatment program on eating behavior in overweight and obese preschool children

<https://doi.org/10.1515/jpem-2017-0390>

Received September 29, 2017; accepted March 5, 2018; previously published online April 13, 2018

## Abstract

**Background:** The effects of multidisciplinary treatment programs on eating behavior in overweight preschool-aged children are largely unknown. We evaluated a multidisciplinary intervention program on eating behavior in 3- to 5-year-old overweight children, comparing them with children given standard treatment. We also assessed the parental eating behavior changes and investigated associations between parents and children.

**Methods:** We randomized 75 children to a multidisciplinary intervention or to a standard care program. During a 16-week period, children and parents in the multidisciplinary group were given dietary advice, physical activity sessions and, for parents only, psychological counseling. Children and parents in the standard group visited a pediatrician 3 times and were given information on a healthy lifestyle. At baseline, after 16 weeks, and after 12 months, children were measured and parents completed the Dutch Child Eating Behavior Questionnaire (DEBQ-C) for their children and the DEBQ for themselves.

**Results:** At the three time points, 70 (93.3%), 57 (91.9%), and 42 (73.7%) DEBQ-Cs were analyzed. We found no differences in the changes in eating behavior between the two groups over time. In both groups, there was a significant increase in restrained eating behavior present at 16 weeks, however, this was no longer present at 12 months. We found no associations between changes in eating behavior between the children and their parents.

\*Corresponding author: Gianni Bocca, MD, PhD, Department of Pediatrics, Beatrix Children's Hospital, University of Groningen, University Medical Center Groningen, P.O. Box 30.001, 9700 RB Groningen, The Netherlands, Phone: +31-50-3619868, Fax: +31-50-3614235, E-mail: g.bocca@umcg.nl

Mirije W.B. Kuitert and Pieter J.J. Sauer: Department of Pediatrics, Beatrix Children's Hospital, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands

Eva Corpeleijn: Department of Epidemiology, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands

**Conclusions:** A multidisciplinary obesity intervention program in preschool-aged children induced more restrained eating behavior between baseline and 16 weeks. However, there was no difference with the children in the standard care group.

**Keywords:** eating behavior; multidisciplinary treatment; obesity; overweight; preschool.

## Introduction

Worldwide, childhood obesity is still increasing, imposing growing costs on healthcare systems. An increase in the prevalence of childhood obesity has also been seen in the Netherlands. Results from the Fifth Dutch Growth Study, performed in 2008 and 2009, showed that 14% of Dutch children were overweight and 2% were obese [1]. Overweight or obese children have an increased risk to develop health problems [2]. For example, cardiovascular risk factors were found in children as young as 3–5 years old [3]. Furthermore, cardiovascular risk factors have been tracked into adolescence [4].

A child's eating behavior plays an important role in the development of overweight [5]. Studies on eating behavior in children with obesity, using questionnaires, have shown associations between the grade of overweight and the children's eating styles [6–8]. Moreover, Ashcroft et al. [9] reported that behaviors associated with a tendency to overeat arise in an early phase of a child's development and show individual continuity. Their study in 4-year-old children also showed that appetitive traits associated with food responsiveness tended to increase over a 6-year period, and that this was consistent with a progressive increase in the risk of obesity [9]. Furthermore, in pre-adolescents, parent-child associations for eating behaviors have been demonstrated, especially regarding eating in response to the sight or smell of food [10].

Three styles of eating behavior have been defined: restrained, emotional and external eating. Restrained eating implies that there is a conscious determination and effort to restrict food intake in order to control body weight. Emotional eating implies eating in response to

negative emotions and is associated with excessive snacking [11]. External eating means eating in response to external food cues that appeal to the senses. In general, external and emotional eating are associated with a tendency to overeat and with a higher body weight [10, 12].

Retraining eating behavior has been shown to be effective in obese adolescents [13]. However, the fact that eating behavior develops in early childhood implies that especially preschool-aged children could benefit from interventions to improve eating behavior. We therefore assessed the effect of a multidisciplinary intervention program on eating behavior in 3- to 5-year-old overweight or obese children and their parents, and compared them with a group of similar children given a standard treatment program. We hypothesized that the intensive dietary and psychological counseling offered in the multidisciplinary setting would reduce obesity-prone eating behavior and increase behavior associated with a normal body weight. We also assessed associations between changes in the eating behavior of the children and of their parents.

## Subjects and methods

Details regarding the multidisciplinary and standard treatment programs have been described previously [14]. In brief, 75 children aged 3–5 years old with overweight or obesity, as defined by the International Obesity Task Force, were randomly assigned to a multidisciplinary intervention program or to a standard care program. Children were excluded from the study if they had a medical condition leading to overweight, or if they had mental retardation or behavioral problems. The primary outcome of the multidisciplinary intervention program was the change in body mass index (BMI) z-score. All children in the study had a Dutch Caucasian background, except for five children originating from former Dutch colonies (two from Suriname and three from the Dutch Antilles), and one child was Moroccan. The children lived in the Northern part of the Netherlands, in urban as well as in rural regions.

A total of 40 children were assigned to the multidisciplinary program and 35 to the standard program. The multidisciplinary program lasted 16 weeks and consisted of six sessions with dietary advice given by a dietician, 12 physical activity sessions supervised by a physiotherapist, and, for parents only, six psychological counseling sessions provided by a psychologist. The dietician educated the children and their parents on improving eating behavior. For example, they were advised to have breakfast every morning; to have, at most, three snacks per day, and to avoid consuming soft drinks. Personal goals regarding the diet were set and evaluated during consecutive sessions. In the psychological sessions, parents were taught how to be a healthy role model for their children. They were also taught ways to change family attitudes toward a healthy lifestyle, for example, by using healthy rewards for their children and by removing unhealthy food triggers from the house. The standard program also lasted 16 weeks. In this period, children and their parents were seen 3 times by a pediatrician who advised them on a healthy lifestyle.

Anthropometry and assessment of body composition were performed at the start and end of both programs, and again, 1 year after the start of the program. The study was approved by the Medical Ethics Committee of the University Medical Center Groningen and informed consent was obtained from the parents or legal guardians. Our procedures were in accordance with the 1975 Declaration of Helsinki, as revised in 2008.

The children's eating behavior was assessed at baseline, 16 weeks, and 12 months, using a version of the Dutch Eating Behavior Questionnaire (DEBQ) specifically adapted for young children (DEBQ-C); this was filled in by one of the parents. The DEBQ-C consists of 20 questions assessing restrained, emotional and external eating. Each question has three possible answers: no, sometimes and yes. The numerical range for the DEBQ-C scales is 1–3. The scores are compared with norm scores for boys and girls, with a higher score implying that the specific type of eating behavior is above the norm, i.e. more pronounced.

Eating behavior in both parents was assessed using the DEBQ. The DEBQ consists of 33 questions covering restrained, emotional and external eating. Each question has five possible answers: never, seldom, sometimes, often and very often. The numerical range for the DEBQ scales is 1–5. Again, a higher score represents a more pronounced eating behavior. For both questionnaires, the final score for each type of eating behavior was calculated by dividing the total score of each subscale by the number of questions covering that particular subscale. If any responses were missing, the total score for the subscale was calculated according to the DEBQ-C instruction manual. Also, data regarding the educational level of both parents were collected by questionnaire, and classified by the researchers as low, moderate or high.

Statistical analysis was performed using IBM SPSS Statistics version 22 (IBM, Armonk, NY, USA). The distribution of normality was tested using descriptive analyses and the one-sample Kolmogorov-Smirnov test. To determine within-group differences, we used the Wilcoxon signed ranks test to assess differences between baseline and 16 weeks, and the Friedman test for differences between baseline and 12 months. In the case of significant differences between baseline and 12 months, a *post hoc* analysis was performed using a Bonferroni correction. To determine differences between the groups over time, the Mann-Whitney test was used on the differences between baseline and 16 weeks, and between baseline and 12 months. Spearman rank tests were used to assess associations between the children's and parental eating behavior at baseline, and between changes in eating behavior of the child and the parents at 16 weeks and at 12 month follow-up. The level of significance for all our main analyses was 0.05, while for *post hoc* analyses it was 0.025.

## Results

The 75 children (54 girls/21 boys) in this study had a mean (standard deviation [SD]) age of 4.7 (0.8) years: 29 children (38.7%) were overweight and 46 (61.3%) were obese. Table 1 shows the baseline descriptive and anthropometric characteristics of the children participating in the study. During the treatment period, seven and six children were lost to follow-up in the multidisciplinary and standard groups, respectively. Between the end of the 16-week

**Table 1:** Descriptive and anthropometric characteristics of the children in the study.

	Multidisciplinary intervention group (n=40)	Standard care group (n=35)
Boys, n (%)	12 (30.0)	9 (25.7)
Girls, n (%)	28 (70.0)	26 (74.3)
Age, years <sup>a</sup>	4.6 (0.8)	4.7 (0.8)
Overweight, n (%)	14 (35.0)	15 (42.9)
Obese, n (%)	26 (65.0)	20 (57.1)
Body mass index, kg/m <sup>2a</sup>	21.2 (2.9)	21.0 (2.7)
Body mass index z-score <sup>a</sup>	2.7 (1.0)	2.7 (1.0)

<sup>a</sup>Data are expressed as mean (standard deviation).

period and the 12-month follow-up, another child in the multidisciplinary group and four children in the standard group were lost. In total, 57 children completed the study. The effect of both treatment programs on BMI z-score and other parameters for overweight has been described previously [14]. In brief, children in the multidisciplinary intervention group showed a larger reduction in mean BMI z-score than the children who received standard care, both at the end of the 16-week program and at 12 months from baseline.

At the start of both programs, at 16 weeks and at 12-month follow-up, we had 70 (93.3% of the children), 57 (91.9%) and 42 (73.7%) DEBQ-Cs available for analysis. At 12-month follow-up, there was no statistically significant difference in weight loss between the children from the parents who did and who did not complete the questionnaire. Table 2 shows the baseline scores for the three types of eating behavior, and the changes in these scores over time for both groups. At baseline, boys and girls in both groups had a restrained eating behavior that was below average, compared with DEBQ-C norm scores. External eating behavior was above average in the boys and girls in the multidisciplinary intervention group, but

average in the children in the standard group. Emotional eating behavior was average for boys and girls in both groups. For both groups combined, there were no associations found between the children's BMI z-scores and their eating behavior, although the weak correlation with emotional eating almost reached statistical significance ( $r^2=0.002$ ,  $p=0.051$ ).

Between the groups, there were no statistically significant differences in the three types of eating behavior at baseline, nor in the changes seen over time. However, within the multidisciplinary group, between baseline and at the end of the treatment program, we observed a statistically significant increase in restrained eating behavior ( $p=0.01$ ), and this was also seen in the children from the standard group ( $p=0.02$ ). This change in restrained eating behavior was not associated with the change in BMI z-score between baseline and 16 weeks. At 12-month follow-up, the increase in restrained eating behavior was no longer present in either group. The scores for emotional and external eating behavior did not change over time.

Table 3 shows the educational level of both parents in the multidisciplinary intervention and standard care groups. There were no statistically significant differences between the groups, neither for the mothers, nor for the fathers. Table 4 shows the baseline scores for the three types of eating behavior, and the changes over time for the children's parents. For the mothers, 70 (93.3%), 58 (93.5%) and 41 (71.9%) DEBQs were available for analysis, at baseline, 16 weeks, and 12 months, respectively. The mean (SD) age of the mothers in the multidisciplinary group and in the standard group was 35.8 (5.6) years and 34.6 (4.7) years, respectively. Median (25th; 75th percentiles) BMIs for both groups were 28.2 (24.1; 33.9) kg/m<sup>2</sup> and 26.8 (23.8; 35.3) kg/m<sup>2</sup>, respectively. Combining both groups, we saw no correlation between the mothers' BMI and their eating behavior at baseline.

Comparing both groups over time, we found no statistically significant different changes in the mothers' eating

**Table 2:** Children's baseline eating behavior scores and the changes from baseline to the end of the 16-week treatment program and to 12 months after the start of the intervention.

Type of eating behavior	Multidisciplinary intervention group			Standard care group		
	Baseline (n=37)	16 weeks <sup>a</sup> (n=30)	12 months <sup>a</sup> (n=22)	Baseline (n=33)	16 weeks <sup>a</sup> (n=27)	12 months <sup>a</sup> (n=20)
Restrained	1.1 (1.0; 1.4)	0.1 (0.0; 0.6) <sup>b</sup>	0.2 (0.0; 0.4)	1.0 (1.0; 1.3)	0.0 (0.0; 0.4) <sup>c</sup>	0.3 (0.0; 0.5)
Emotional	1.1 (1.0; 1.4)	0.0 (-0.3; 0.1)	0.0 (-0.4; 0.1)	1.0 (1.0; 1.3)	0.0 (-0.1; 0.0)	0.0 (-0.3; 0.1)
External	2.5 (2.2; 2.8)	0.0 (-0.3; 0.2)	-0.1 (-0.5; 0.0)	2.3 (1.7; 2.8)	-0.2 (-0.3; 0.3)	0.0 (-0.2; 0.3)

Numbers are expressed as median (25th; 75th percentiles) at baseline and as median change (25th; 75th percentiles) at 16 weeks and 12 months. <sup>a</sup>Positive numbers indicate an increase over time. <sup>b</sup>Statistically significant increase compared with baseline (Wilcoxon signed ranks test,  $p=0.01$ ). <sup>c</sup>Statistically significant increase compared with baseline (Wilcoxon signed ranks test,  $p=0.02$ ).

**Table 3:** Educational level of the parents participating in the study.

Educational level	Multidisciplinary intervention group	Standard care group
Mothers		
Low	28	20
Moderate	51	60
High	21	20
Fathers		
Low	28	41
Moderate	42	33
High	31	26

Numbers are expressed as percentages.

behavior. However, between baseline and 16 weeks, we saw a trend toward more restrained eating behavior in the multidisciplinary group, who showed a median decrease ( $p=0.09$ ), compared with the mothers in the standard group. A trend toward a larger increase in external eating behavior between baseline and 12 months was also demonstrated in the standard group mothers ( $p=0.08$ ). When we evaluated the changes within each group, mothers in the multidisciplinary intervention group showed a trend toward more restrained eating behavior between baseline and 16 weeks ( $p=0.09$ ), and between baseline and 12 months ( $p=0.06$ ). A trend toward a decrease in emotional eating behavior was also observed in the standard group mothers between baseline and 16 weeks ( $p=0.07$ ).

For the fathers, we had 61 (81.3%), 47 (75.8%) and 33 (57.9%) DEBQs available at consecutive time points.

The mean (SD) age of the fathers in the multidisciplinary intervention group and in the standard group was 39.6 (6.4) years and 39.6 (4.7) years, respectively. Median (25th; 75th percentiles) BMI for both groups were 27.7 (24.6; 30.3)  $\text{kg}/\text{m}^2$  and 28.2 (25.8; 30.5)  $\text{kg}/\text{m}^2$ , respectively. At baseline, there was a positive, although weak, association with the fathers' BMI for all three types of eating behavior: for restrained  $r^2=0.10$  ( $p=0.02$ ), external  $r^2=0.15$  ( $p=0.01$ ) and emotional eating behavior,  $r^2=0.16$  ( $p=0.01$ ).

Comparing the groups at baseline, fathers in the multidisciplinary intervention group had statistically significant less restrained eating behavior than fathers of children in the standard group. Comparing both groups over time, fathers in the multidisciplinary intervention group showed significantly higher increases in emotional and external eating behavior at the end of the 16-week program compared with standard group fathers. The larger increase in restrained eating behavior seen in fathers in the multidisciplinary intervention group at 16 weeks almost reached statistical significance ( $p=0.050$ ) compared with standard group fathers. At 12-month follow-up, fathers in the multidisciplinary intervention group showed a median increase in external eating behavior compared with a median decrease in the fathers from the standard group. This difference was statistically significant. When we evaluated within-group changes, we found only a statistically significant change in emotional eating behavior for the fathers in the multidisciplinary intervention group between baseline and 12 months.

**Table 4:** Parental eating behavior scores at baseline and the changes from baseline to the end of the 16-week treatment program and to 12 months after the start of the intervention.

Type of eating behavior	Multidisciplinary intervention group			Standard care group		
	Baseline	16 weeks <sup>a</sup>	12 months <sup>a</sup>	Baseline	16 weeks <sup>a</sup>	12 months <sup>a</sup>
<b>Mothers</b>	<b>(n=37)</b>	<b>(n=31)</b>	<b>(n=21)</b>	<b>(n=33)</b>	<b>(n=27)</b>	<b>(n=20)</b>
Restrained	3.2 (2.8; 3.7)	0.1 (-0.3; 0.8)	0.1 (-0.2; 0.7)	3.1 (2.6; 3.5)	-0.1 (-0.2; 0.2)	-0.1 (-0.3; 0.2)
Emotional	2.6 (2.1; 3.1)	-0.1 (-0.5; 0.3)	-0.1 (-0.5; 0.3)	2.2 (1.5; 2.8)	-0.2 (-0.4; 0.1)	-0.1 (-0.3; 0.1)
External	2.8 (2.5; 3.1)	0.0 (-0.2; 0.2)	0.0 (-0.5; 0.1)	2.6 (2.2; 3.0)	0.0 (-0.2; 0.3)	0.1 (-0.1; 0.3)
<b>Fathers</b>	<b>(n=35)</b>	<b>(n=25)</b>	<b>(n=19)</b>	<b>(n=26)</b>	<b>(n=22)</b>	<b>(n=14)</b>
Restrained	2.2 (1.4; 2.7) <sup>b</sup>	0.3 (-0.1; 0.6)	0.2 (-0.2; 0.6)	2.9 (1.9; 3.2)	0.0 (-0.2; 0.3)	0.1 (-0.2; 0.5)
Emotional	1.6 (1.2; 2.4)	0.2 (-0.1; 0.8) <sup>c</sup>	0.0 (-0.2; 0.4)	1.6 (1.3; 2.3)	0.0 (-0.2; 0.1)	0.0 (-0.2; 0.3)
External	2.6 (2.2; 2.9)	0.1 (-0.1; 0.3) <sup>d</sup>	0.1 (-0.2; 0.2) <sup>e</sup>	2.9 (2.5; 3.4)	-0.3 (-0.4; 0.2)	-0.2 (-0.3; 0.0)

Numbers are expressed as median (25th; 75th percentiles) at baseline and as median change (25th; 75th percentiles) at 16 weeks and 12 months. <sup>a</sup>Positive numbers indicate an increase over time. <sup>b</sup>Statistically significant lower score in the multidisciplinary intervention group compared with the standard care group ( $p=0.02$ ). <sup>c</sup>Statistically significant higher increase in the multidisciplinary intervention group compared with the standard care group ( $p=0.01$ ). <sup>d</sup>Statistically significant higher increase in the multidisciplinary intervention group compared with the standard care group ( $p=0.03$ ). <sup>e</sup>Statistically significant higher increase in the multidisciplinary intervention group compared with the standard care group ( $p=0.04$ ).



At baseline, for both groups together, there was a statistically significant correlation between external eating behavior of the mothers and of their children ( $r^2=0.34$ ,  $p<0.001$ ). No other correlations were present at baseline, neither between both parents, nor between the children and their fathers. During the 16-week treatment period, we found no associations between changes in restrained eating behavior between both parents nor between the parents and their children in the multidisciplinary treatment group. In the standard group, we found a positive association in the change in restrained eating behavior between the mothers and fathers ( $r^2=0.17$ ,  $p=0.03$ ). Regarding changes in emotional eating behavior, between baseline and 16 weeks, we found only a positive association between both parents in the multidisciplinary intervention group ( $r^2=0.14$ ,  $p=0.03$ ).

## Discussion

We aimed to assess the effect of a multidisciplinary treatment program for overweight or obese preschool children on their eating behavior and on the parents' eating behavior. We compared the effect with children and parents given a standard care program. In both groups, children showed an increase in restrained eating behavior between baseline and 16 weeks, although this effect was not statistically significantly different between the groups. In the mothers, we found no significant changes over time in the three types of eating behavior. Remarkably, the fathers of the children in the multidisciplinary treatment group showed a statistically significant higher increase in emotional and external eating behavior between the start and the end of the program compared with the fathers of the children given standard care. An increase in external eating behavior in the multidisciplinary intervention group was still present after 12 months.

Changing eating habits is a cornerstone in the treatment of childhood obesity, as there is a clear association between obesity and eating behavior, leading to more than necessary food consumption in 6- to 12-year-old children [15]. In contrast, this study also demonstrated that eating behavior leading to the avoidance of food was inversely associated with obesity. Even in 3- to 5-year-olds, an association between BMI-SD and appetitive traits as food cue responsiveness was present [16]. Moreover, behavior associated with overeating has shown individual continuity between age 4 and 10 years [9], and was demonstrated in a large part of 127 obese children with a mean age of 11.8 years [17]. So, changing eating behavior in preschool

children may prevent the development of overweight and obesity in childhood and adolescence. Although we found no differences in the changes in eating behavior between the two groups over time, children in both groups showed more restrained eating behavior by the end of the program. Unfortunately, this effect could no longer be seen after 12 months.

Our multidisciplinary treatment program was aimed at changing lifestyle in the obese child's family, including the parents. The importance of parental participation in childhood obesity treatment programs was emphasized by a study in Dutch children aged 6–7 years that showed parental feeding styles, such as offering food in response to a child's distress or using food as a reward, are positively related to children's snacking behavior [18]. Offering dietary advice and psychological counseling for parents, in order to help change their eating habits, could therefore benefit their obese child too. We found a strong correlation between the external eating behavior of the mother and child at baseline. However, no associations could be demonstrated for changes in eating behavior between the children and their parents during the 16-week treatment period.

Since no changes in eating behavior over time could be demonstrated between the two groups of mothers, it was remarkable that the fathers in the multidisciplinary intervention group showed more emotional and external eating behavior between baseline and 16 weeks when compared with the fathers in the standard group. However, we found no associations between changes in the fathers' eating behavior and their children's. We can hypothesize that the fathers became more aware of their eating behavior by participating in the dietary and psychological counseling sessions of the multidisciplinary program. To the best of our knowledge, there is no literature on fathers' awareness of their eating behavior. Our findings in the fathers participating in the multidisciplinary treatment program deserve further study. It can be speculated that increasing paternal awareness of their own eating behavior could influence how they offer food to their children. This could be important, as a study has shown paternal feeding styles influence eating behavior and BMI in preschool children [19].

Two strong points of our study were the children's young age and that both parents participated in the study. As discussed earlier, changing eating behavior in young children is worthwhile, as the behavior associated with overeating develops at a young age and persists over time [9]. Furthermore, involving parents in obesity treatment programs for young children should be mandatory, as demonstrated by Ek et al. [20]. Their study, which involved

478 children with a mean age of 5.5 years and 20% being overweight or obese, clearly showed that children's eating behavior was associated with parental feeding practices. Restrictive behavior towards children with big appetites was especially pronounced when the parents were also concerned about their child's weight. Another study in a large population of 4-year-old Dutch children supported the findings that a child's eating behavior and the parental feeding practices were strongly associated with a child's BMI, and that this association was particularly present in overweight children [21]. Ek et al. [20] concluded that obesity interventions for children should also address the parents' perceptions of healthy eating.

A limitation of our study was the use of the DEBQ-C in children with a mean (SD) age of 4.7 (0.8) years. The DEBQ-C was constructed for use in 7- to 12-year-old children [12]. However, an age-adapted version of the DEBQ has been successfully used in children as young as 4.6- to 6.4-years-old [22], and its applicability in studies of overweight has also been proven in Dutch children aged 6–7 years [6]. We therefore believe that our results are valid and reflect the effects of the multidisciplinary obesity treatment program on the eating behavior of preschool children in our study. Another limitation was the relatively low number of participants, which made it more difficult to demonstrate significant effects on the children's and parents' eating behavior. However, in general, we had a high response with completed questionnaires.

In conclusion, our study showed that both a 16-week multidisciplinary treatment program and standard care for overweight or obese children with a mean age of 4.7 years led to a more restrained eating behavior. However, we could not determine an association between changes in the children's BMI z-score and changes in their eating behavior. More studies with larger numbers of participants and involving the parents should be performed to further elucidate how eating behavior in young overweight children can be improved. The insights gained can be used to optimize multidisciplinary obesity treatment programs that involve dietary and psychological counseling.

**Author contributions:** All the authors have accepted responsibility for the entire content of this submitted manuscript and approved submission.

**Research funding:** This study was sponsored by an unrestricted grant from Hutchison Whampoa Limited, Hong Kong.

**Employment or leadership:** None declared.

**Honorarium:** None declared.

**Competing interests:** The funding organization played no role in the study design; in the collection, analysis, and

interpretation of data; in the writing of the report; or in the decision to submit the report for publication.

## References

- Schönbeck Y, Talma H, van Dommelen P, Bakker B, Buitendijk SE, et al. Increase in prevalence of overweight in Dutch children and adolescents: a comparison of nationwide growth studies in 1980, 1997 and 2009. *PLoS One* 2011;6:e27608.
- Ebbeling CB, Pawlak DB, Ludwig DS. Childhood obesity: public-health crisis, common sense cure. *Lancet* 2002;360:473–82.
- Bocca G, Ongering EC, Stolk RP, Sauer PJ. Insulin resistance and cardiovascular risk factors in 3- to 5-year-old overweight or obese children. *Horm Res Paediatr* 2013;80:201–6.
- Bugge A, El-Naaman B, McMurray RG, Froberg K, Andersen LB. Tracking of clustered cardiovascular disease risk factors from childhood to adolescence. *Pediatr Res* 2013;73:245–9.
- Obregón AM, Pettinelli PP, Santos JL. Childhood obesity and eating behavior. *J Pediatr Endocrinol Metab* 2015;28:497–502.
- 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.
- Webber L, Hill C, Saxton J, van Jaarsveld CH, Wardle J. Eating behaviour and weight in children. *Int J Obes (Lond)* 2009;33:21–8.
- Viana V, Sinde S, Saxton JC. Children's eating behaviour questionnaire: associations with BMI in Portuguese children. *Br J Nutr* 2008;100:445–50.
- Ashcroft J, Semmler C, Carnell S, van Jaarsveld CH, Wardle J. Continuity and stability of eating behaviour traits in children. *Eur J Clin Nutr* 2008;62:985–90.
- Elfhag K, Tynelius P, Rasmussen F. Family links of eating behaviour in normal weight and overweight children. *Int J Pediatr Obes* 2010;5:491–500.
- Elfhag K, Tholin S, Rasmussen F. Consumption of fruit, vegetables, sweets and soft drinks are associated with psychological dimensions of eating behaviour in parents and their 12-year-old children. *Public Health Nutr* 2008;11:914–23.
- Van Strien T, Oosterveld P. The children's DEBQ for assessment of restrained, emotional, and external eating in 7- to 12-year-old children. *Int J Eat Disord* 2008;41:72–81.
- Ford AL, Bergh C, Södersten P, Sabin MA, Hollinghurst S, et al. Treatment of childhood obesity by retraining eating behaviour: randomised controlled trial. *Br Med J* 2010;340:b5388.
- Bocca G, Corpeleijn E, Stolk RP, Sauer PJ. Results of a multidisciplinary treatment program in 3-year-old to 5-year-old overweight or obese children. A randomized controlled clinical trial. *Arch Pediatr Adolesc Med* 2012;166:1109–15.
- Santos JL, Ho-Urriola JA, González A, Smalley SV, Domínguez-Vásquez P, et al. Association between eating behavior scores and obesity in Chilean children. *Nutr J* 2011;10:108.
- Carnell S, Wardle J. Appetite and adiposity in children: evidence for a behavioral susceptibility theory of obesity. *Am J Clin Nutr* 2008;88:22–9.
- Slyper AH, Kopfer K, Huang WM, Re'em Y. Increased hunger and speed of eating in obese children and adolescents. *J Pediatr Endocrinol Metab* 2014;27:413–7.

18. Sleddens EF, Kremers SP, de Vries NK, Thijs C. Relationship between parental feeding styles and eating behaviours of Dutch children aged 6–7. *Appetite* 2010;54:30–6.
19. Vollmer RL, Adamsons K, Foster JS, Mobley AR. Association of fathers' feeding practices and feeding style on preschool age children's diet quality, eating behavior and body mass index. *Appetite* 2015;89:274–81.
20. Ek A, Sorjonen K, Eli K, Lindberg L, Nyman J, et al. 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. *PLoS One* 2016;11:e0147257.
21. Jansen PW, Roza SJ, Jaddoe VW, Mackenbach JD, Raat H, 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.
22. Carper J, Orlet Fisher J, Birch LL. Young girls' emerging dietary restraint and disinhibition are related to parental control in child feeding. *Appetite* 2000;35:121–9.