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ORIGINAL ARTICLE

Restrained eating in overweight children: Does eating style run in families?

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Abstract
Overweight children show abnormalities in eating style, such as restrained eating and tendency toward overeating (comprising both emotional and external eating). Family surroundings play a major role in developing eating behaviors in children. We tested whether restrained eating and tendency toward overeating predicted the amount of food intake in 41 overweight children (23 girls and 18 boys) and their parents (40 mothers and 11 fathers) after receiving a preload. We further investigated with questionnaires whether there were associations between the parents' and their children's eating behavior and whether mothers' food intake predicted the amount of food consumed by children in an experimental trial. We found that neither children with restrained eating nor their mothers ate more after a preload, but children with a high tendency toward overeating ate somewhat more after receiving a preload. Further analyses showed that children's food intake in the preload paradigm was predicted by mothers' food intake. Our findings point to a familial transmission of eating styles: children eat as their primary caregivers do, even when the caregivers are not present in the laboratory.

Key words: *Children, discriminative stimulus, eating styles, family eating patterns, overeating, overweight, preload paradigm, restrained eating, tendency toward overeating, transmission*

Introduction

In the United States and in Europe, prevalence rates of overweight and obesity in childhood are increasing alarmingly. Overweight children have a twofold risk of becoming obese adults compared with normal-weight children, indicating that the prevention of adult obesity should start in childhood (1). The mechanisms responsible for overweight and obesity are complex. Besides genetic factors, environmental factors act as determinants of energy intake and expenditure (2). Eating style is one of the basic environmental factors and has a major influence on energy intake.

Three important psychological theories have been developed to explain eating styles in obese individuals: psychosomatic theory, which focuses on the phenomenon of emotional eating as a response to a state of arousal (3); externality theory, which emphasizes a higher sensitivity toward external, food-related stimuli (4); and restraint theory, which refers to an eating style that is affected by the physiological pressure to eat and a non-physiological, self-imposed resistance to eating to achieve weight loss or prevent weight gain (i.e. restrained eating) (5). According to Westenhoefer et al. (1994) (6), dietary restraint is not a homogenous construct but includes rigid and flexible control. Rigid control is characterized by an "all or nothing" cognitive style with respect to, for instance, forbidden food. Flexible control includes strategies such as the "allowance" of limited amounts of forbidden food without feelings of guilt or planned compensations. With overweight children, studies report elevated scores of external and emotional eating as well as engagement in restrained

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eating in an attempt to restrict energy intake to achieve society's beauty ideal of thinness (7).

The development of eating style in children is heavily influenced by the attitudes toward eating and the role model behavior of parents with respect to the type of food consumed and how, where, and at what speed it is eaten. Parental influence on eating style might be transmitted for instance, through specific instructions, via modeling and reinforcement (8). There is further evidence that eating style (such as bite size) might also be transmitted genetically (9). Results from both questionnaire and experimental studies show that mothers' rigid approach to child feeding practices may impede the development of self-control of food intake, as children learn to focus on external cues instead of internal cues of hunger and satiety (10–12). Other experimental studies have found that mothers' monitoring of eating behavior decreased obese children's self-control in the laboratory (8). The results suggest that laboratory-eating behavior of obese children might be a result of previous maternal reinforcing processes, such as prompting high eating rates and large bites. Thus the mother might have become a discriminative stimulus for eating, even when she is not prompting (8).

In the present study, we investigated 8- to 12-year-old overweight boys and girls and their parents from a treatment-seeking sample using questionnaires and the classical preload paradigm (5). Following restraint theory, we wanted to know whether overweight children who engage in restrained eating would show a disinhibition effect under the experimental condition of receiving a preload, whereas less restrained eaters would regulate their food intake and eat less after a preload. Recent findings, however (13,14), indicate that a tendency toward overeating predicts food consumption in overweight children and their parents. Therefore, we expanded our hypothesis and tested whether the combined effect of external and emotional eating (tendency toward overeating) rather than restrained eating would predict food consumption in overweight children and their parents. Based on the literature, we further assumed that eating behavior runs in families (15). Thus in the present study we investigated eating styles in mothers and their overweight children, as assessed by questionnaires, and by examining eating patterns in mothers, daughters, and sons when manipulated in the preload paradigm (5). We further explore whether the amount of food intake of mothers was a predictive value of the amount of food that would be eaten by children manipulated in the same way but in a different room.

Methods

Participants

Participants were overweight children and their parents seeking treatment who responded to newspaper advertisements and flyers announcing a treatment trial for overweight and obese children and their parents (16). The participants were not paid and participation in the experimental trial was voluntary. Inclusion criteria required that participants be 8–12 years old and have a body max index (BMI) above the 85th percentile, which represents the cut-off for "at risk for being overweight" according to the Centers for Disease Control and Prevention (CDC) guidelines (17,18) (Table I). All participants were free from unstable medical conditions, including diabetes, coronary heart disease, and endocrine disorders. Participants were excluded if they met DSM-IV-TR criteria (19) for major depressive disorder, psychosis, or substance abuse disorder for which they should have received prior treatment. Further exclusion criteria were participation in another psychological therapy or in a diet program. The local Ethical Committee Board approved the protocol. Families were asked to participate in an experimental trial that took place before the treatment started entitled "Eating behavior of parents and their children after a preload of milk chocolate." Parents were asked to give written consent for their own as well as for their children's voluntary participation.

Sixty-three children were screened for inclusion criteria by telephone, of which 53 were invited to face-to-face diagnostic interviews that included the

Table I. Means (standard deviations in parentheses) of age, body mass index (BMI), and the DEBQ and DEBQ-K subscales, respectively, for restrained, emotional, and external eating of mothers, daughters, and sons.

	Age (in years)	BMI (kg/m^2)	DEBQ/DEQ-K Restrained	DEBQ/DEBQ-K Emotional	DEBQ/DEBQ-K External
Mothers	39.6 (4.8)	28.8 (6.0)	1.65 (0.83)	1.38 (0.77)	1.78 (0.69)
	$n=38$	$n=39$	$n=40$	$n=40$	$n=40$
Daughters $n=23$	9.6 (1.5)	27.2 (4.3)	1.61 (0.70)	0.56 (0.59)	1.46 (0.55)
Sons $n=18$	10.9 (1.5)	26.8 (3.5)	1.48 (0.59)	0.74 (0.80)	1.59 (0.47)

DEBQ: Dutch eating behavior questionnaire, German version (25); DEBQ-K: DEBQ for children, German version (26).

parents' Eating Disorder Examination (EDE), German version (20) and the MINI-DIPS (21), and for children the "Kinder-DIPS" (22), which allow the screening of mental disorders on Axis-I according to the DSM-IV (23) by trained interviewers. After being re-evaluated to ensure that they met inclusion criteria, only 41 children (23 girls and 18 boys) and 51 parents (40 mothers and 11 fathers) agreed to participate in the experimental trial (see Table I). Reasons for nonparticipation of the remaining 12 families were lack of time (6 families) or lack of interest (6 families). As only six fathers agreed to participate in the experimental trial, we decided to exclude them from our data set.

Assessment

Weighted BMI. Children's and mothers' weight was assessed in light clothes to the nearest 0.1 kg on a Seca electronic balance (Seca, Vogel and Halke, Germany) and height was measured without shoes to the nearest 0.1 cm with a stadiometer. BMI was then calculated as weight in kilograms divided by the square of height in meters. Children's percent overweight was established by comparing the children's BMI with the 50th BMI percentile based on age and gender (24).

Eating behavior. The following questionnaires were used to measure different dimensions of eating behavior: the Dutch Eating Behavior Questionnaire (DEBQ), German version (25), and the Dutch Eating Behavior Questionnaire for children (DEBQ-K, German version) (26). We decided to use these questionnaires because of their high internal consistency and good psychometric properties, and because the DEBQ/DEBQ-K can measure the tendency toward overeating (26), which is assumed to be more important in obese individuals than restrained eating *per se* (14). In obese adults, findings with the original Restraint Scale (RS) in a study by Herman and Polivy and colleagues (27) were inconsistent and no disinhibition effect could be found after a preload (28,29).

The DEBQ and the DEBQ-K are both 30-item questionnaires comprising three different subscales, namely, emotional eating behavior (overeating in response to emotions, e.g., "I have the desire to eat when I'm depressed or discouraged"), external eating behavior (eating in response to food-related stimuli, regardless of the internal states of hunger and satiety, e.g., "If food smells or looks good, I eat more of it than normal"), and restrained eating behavior (attempts to refrain from eating, e.g., "I eat deliberately less in order not to become heavier"). Items were scored in the child version on a 4-point (0=never, 1=seldom, 2=sometimes, and 3=often) and in the parent version on a 5-point (0=never, 1=seldom, 2=sometimes, 3=often, and 4=very often) Likert-type scale. Parents reached scores between 0 and 4 points on every subscale. The three subscale scores for the DEBQ and DEBQ-K, respectively, were each obtained by averaging over the 10 items. Subscale values for mothers and their children are shown in Table I.

Manipulations and procedure

Mothers and their children were randomly allocated to two study groups: 21 mothers, 10 girls, and 11 boys were assigned to the preload condition, and 20 mothers, 13 girls, and 7 boys to the non-preload condition.

All participants were tested at set times at 3:00 p.m. Mothers and their children were instructed to have a regular lunch but to eat nothing else before the experimental trial. They participated in the experiment in different rooms and all were tested individually under the supervision of an experimenter. Prior to the preload trial they completed questionnaires regarding eating behavior (DEBQ or DEBQ-K).

In the preload condition, the participants were served 50 g of milk chocolate (268 kcal), to trigger disinhibited eating in restrained eaters. The participants in the no-preload condition proceeded directly to the taste test (13).

All participants were asked to taste a standardized pre-weighed amount (500 g) of vanilla, chocolate, and toffee "crème" (a common mousse-like dessert familiar to Swiss families), which were presented in large bowls. Participants were then asked to judge the desserts with respect to taste, texture, and ingredients on prepared forms. Mothers and children were told that after finishing the taste ratings, they could help themselves and eat as much crème as they wanted because they were the last participants of the day and after the experiment the desserts would be thrown away. The experimenter subsequently left the room for some minutes and the participants were asked to come to the investigator when they had finished their taste test. When the participant left, the crème was measured again and the amount eaten was noted. Finally, all participants were debriefed.

Data analysis

Preload experiment. To examine our hypothesis that overweight children, who had a preload would eat higher amounts of food when they were more restrained eaters than when they were less restrained eaters, and that this difference in food intake would

be higher than in children without a preload, we used a generalized linear model (GLM) with preload condition (yes/no) of children as a planned factor, and the restrained subscale of the DEBQ-K as an additional independent variable. The interaction between preload and restrained eating was used to test our hypothesis. The same model was also used with mothers as targets, replacing the DEBQ-K with the DEBQ. We also introduced additional covariates in the model with children as targets to test whether intervening variables, such as children's age, sex, and BMI, affected the results. Covariates were all added simultaneously as independent variables to our GLM.

We further tested whether the tendency toward overeating (combined subscales of emotional and external eating in the DEBQ and DEBQ-K) in combination with the intake of a high-calorie preload would predict food intake after the preload in children and mothers, respectively, as targets. Thus we entered the following independent variables into the equation: tendency toward overeating (emotional and external eating), preload condition (yes/no), and the interaction between these two variables. Note that we deliberately chose not to dichotomize the continuous variable DEBQ/DEBQ-K (e.g., by using a median split) because doing so usually leads to loss of information.

Associations in restrained, emotional, and external eating style between mothers, daughters, and sons on a self-report basis. To test whether maternal eating behavior as assessed in questionnaires influences the corresponding traits in children, we used three separate hierarchical linear regression models. Each model corresponds to a different dependent variable: children's restrained, external, and emotional eating, respectively, according to the DEBQ-K. Independent variables were entered into the equation of each model in chronological order of development, that is, mother's characteristics first, followed by the child's characteristics. Thus Block 1 contained the BMI and the DEBQ of the mother, and Block 2 contained the child's sex, BMI, and age (30). If an entire block had a significant effect we looked at the impact of the individual variables within that block, otherwise we did not. This procedure was chosen to reduce the risk of finding chance effects as a result of multiple testing (31).

Associations of eating behavior between mothers, daughters, and sons in the preload experiment. Finally we tested possible associations of eating behavior between mothers and their children in the preload paradigm. Following examples in the literature, we included variables representing attempts to restrain food intake and to control weight of mothers and children. We further included mothers' food intake when experimentally manipulated as an indicator of familial eating behavior (31). We thus set up a GLM with the amount of crème eaten by the child as the dependent variable and the following independent variables: preload condition (yes/no) and in chronological order of development: restrained eating behavior of the mother, actual amount of crème eaten by the mother, child's sex, child's restrained eating, and interaction of the amount of crème eaten by the mother with child's sex (hypothesizing that mothers will especially influence their daughter's energy intake) (10).

To meet the assumptions for the statistical models stated above (homoscedasticity, normality) the dependent variables of amounts of crème eaten by the children and their mothers were log-transformed. Data were screened for outliers using standardized residuals and Cook's distances, but no data had to be excluded. Effect sizes denote partial etas squared (η_p^2). All analyses were done using the statistical software package SPSS, version 12.

Results

Effects of the preload experiment

Children and their mothers on average ate 230.1 (standard deviation, SD = 252.4) and 81.5 (SD = 99.9) grams of crème, respectively (means based on untransformed data).

Children. Children in the preload condition ate approximately the same amounts of crème as children who had received no preload ($F_{1,37} = 0.23$, $p = 0.64$, $\eta_p^2 = 0.006$). In addition, restrained eating did not affect food intake ($F_{1,37} = 0.001$, $p = 0.97$, $\eta_p^2 < 0.001$). The main hypothesis that overweight children who had a preload would eat higher amounts of food when they were more restrained eaters than when they were less restrained eaters and that this difference in food intake would be higher than in children without a preload could not be confirmed (interaction Preload × Restrained Eating: $F_{1,37} = 0.78$, $p = 0.38$, $\eta_p^2 = 0.021$). A non-significant interaction effect was also found when including children's age, sex, and BMI as covariates ($F_{1,33} = 0.17$, $p = 0.68$).

Mothers. As with the children, there were no effects of preload ($F_{1,40} = 0.59$, $p = 0.45$, $\eta_p^2 = 0.016$) or of restrained eating ($F_{1,40} = 0.17$, $p = 0.68$, $\eta_p^2 = 0.005$) on the amount of crème eaten by mothers. Mothers

who were more restrained eaters did not eat more crème if they had received a preload than if they had not (interaction Preload × Restrained Eating: $F_{1,40}=1.0$, $p=0.32$, $\eta_p^2=0.028$).

Influence of children's and mothers' tendency toward overeating in the preload paradigm. Tendency toward overeating, as assessed by the DEBQ and DEBQ-K (emotional and external eating in the DEBQ and DEBQ-K) in combination with a preload, marginally influenced the energy intake of children: children with a lower tendency toward overeating decreased their food intake after having received a preload, whereas children with a higher tendency toward overeating did not alter their food intake in response to a preload (interaction between preload and tendency toward overeating: $F_{1,37}=3.22$, $p=0.081$). With mothers, regardless of whether they had received a preload or not, their food intake was not influenced by the tendency toward overeating as assessed by the DEBQ (interaction between preload and tendency toward overeating: $F_{1,36}=2.09$, $p=0.16$).

Associations in restrained, emotional, and external eating style between mothers, daughters, and sons on a self-report basis

Results from hierarchical linear regression analyses show that the first block (Block 1) containing maternal restrained eating and BMI had a significant influence on children's restrained eating ($F_{2,38}=3.69$, $p=0.035$ for the entire block), whereas Block 2, which contained children's sex, BMI, and age, did not ($F_{3,33}=1.26$ $p=0.30$). Within Block 1, it was mothers' restrained eating that had a significant positive influence on children's restrained eating ($F_{1,38}=6.81$, $p=0.013$) whereas mothers' BMI had no significant effect ($F_{1,38}=2.13$, $p=0.153$). Children's external and emotional eating were both not affected by any of the maternal or children's variables ($p>0.2$ for Blocks 1 and 2 in each of the two dependent variables).

Associations in eating behavior between mothers, daughters, and sons in the preload experiment

The analysis of maternal influence shows that the amount of crème eaten by mothers was positively related to the amount of crème eaten by their children ($F_{1,34}=5.25$, $p=0.029$). Food intake was further influenced by children's sex ($F_{1,34}=8.07$, $p=0.008$), with boys on average eating more than girls. At the same time, there was no interaction effect between maternal amount of crème eaten and sex ($F_{1,40}=0.16$, $p=0.697$). Further, neither mothers' nor children's restrained eating behavior nor the preload condition had a significant effect on children's food intake ($p>0.2$ for all three effects).

Discussion

The present study tested the influence of a preload in combination with restrained eating behavior in a treatment-seeking sample of overweight children and their mothers. We further investigated whether food intake of mothers, as a measure of modeling, vicarious reinforcement, and possible genetic transmission of eating behavior patterns, influenced the amount of a dessert eaten by their children. We expected that the more the overweight children restrained their eating behavior, the more they would be vulnerable to our experimental manipulation in the preload condition and thus the more crème they would eat (the disinhibition effect). This was not the case. Contrary to our expectations, children and mothers who had a restrained eating style did not eat more after receiving a preload relative to less restrained children and mothers.

Our results are similar to findings in normal-weight persons, where the restrained subscale of the DEBQ instead of the original RS was used and disinhibition was not found (6,13,14). We further corroborate results of studies from several research groups using the RS who did not find a disinhibition effect in either normal-weight adults or obese adults for a clinical and non-clinical sample (for an overview see for example Ouwens et al.) (14). In line with current research, we found indications that overweight children with a high tendency toward overeating (measured using the emotional and external subscale of the DEBQ) could not regulate energy intake after receiving a preload compared with children with less tendency toward overeating. The same but less pronounced eating behavior patterns were found with their mothers. These variables might be forerunners of overweight and obesity in childhood (6,14). However, it is worth noting that the model only reached statistical significance at an error probability of 10%. The validity of this finding is further reduced as the model we used likely suffered from overfitting due to the relatively small sample size ($N=41$) in relation to the model's complexity. Our preliminary results thus need to be confirmed using a larger sample.

We further found that maternal restrained eating was a predictor of the degree of children's restrained eating, assessed by questionnaires, independent of the children's sex. Nevertheless, in the preload paradigm, mothers' restrained eating had no influence on children's energy intake. It was only the actual amount of crème eaten by the mother that

predicted her daughter's or son's food intake. Based on the findings of previous research (8), suggesting that the mothers might have become a discriminative stimulus for eating, we expected that the mothers' food intake would influence that of their children. In our study a mother's food consumption behavior predicted her child's energy intake although mother and child were tested in different rooms. This could be an effect of further generalization of original eating cues. In other words, the eating situation *per se* might trigger a certain eating style that is learned in the familial context mostly from mothers.

Alternatively, our findings could represent the result of a genetically transmitted pattern of energy intake (9). Future studies should investigate whether this familial eating style is characterized by a correspondence of eating rates and bite size, possibly triggered by the exposure to a large amount of food.

There are several limitations in the design of this study. First, our study sample was quite small. For example, assuming a medium effect size f of 0.25 (or $\eta_p^2 = 0.059$) for the interaction effect between preload and restrained eating behavior (one of our main hypotheses), a sample size of 128 subjects would be necessary (for α and $1-\beta = 0.8$). Second, eating behavior of children and their parents was investigated in a laboratory situation using a taste test. This raises the question of external validity, as participants might react differently in their natural environment. We also did not include the bulimic eating scale of the Revised Eating Disorders Inventory, EDI-2 (32) in our tendency toward overeating score (13,14). Furthermore, the experimental situation needs further consideration. Obesity is seen by many as abnormal in our culture, and this may be associated with a greater need to be accepted and approved socially. Thus as an attempt to achieve social desirability obese children and their parents might have attempted to meet normative demands and tried even harder to control their eating behavior after a preload.

To conclude, in our laboratory setting, we found further indices of maternal influence on eating style, which could be transmitted genetically, by modeling, or by vicarious reinforcement. Taken together with other studies demonstrating the inter-generational transmission of eating behaviors (9), our results stress the need to devise enhanced therapeutic strategies for treating obesity, which are sensitive to family influence.

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