RESEARCH ARTICLE

Unfavourable Family Characteristics and Their Associations with Childhood Obesity: A Cross-Sectional Study

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Abstract

Objective: This cross-sectional study explores the influence of multiple familial factors on children's weight status and the interaction between parenting stress and unfavourable family characteristics.

Methods: A total of 197 families with children between 6 and 14 years participated in this study. Of this group, 97 families had a child with normal weight and 100 families had a child with overweight. Parents reported on seven family factors (maternal BMI, number of children, family structure, socioeconomic position, life events, parental psychopathology and parenting stress).

Results: Families with overweight children experience more parenting stress. A regression analysis revealed that familial factors explain 27% in the variance in child's weight status. The hypothesis that a combination of familial factors will be more able to explain child's adiposity could not be confirmed.

Conclusions: Familial factors have moderate ability to predict children's weight status. There is a need to identify other familial mechanisms taking into account developmental and temporal evolutions over the past decade.

Keywords

childhood overweight; family factors; parenting stress

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Introduction

The increasing prevalence of paediatric obesity leads to major concerns about its health implications both during childhood and later in adulthood (e.g. Dietz, 1998; Must & Strauss, 1999). In addition, the medical costs to society pose a considerable problem (Finkelstein, Fiebelkorn & Wang, 2003). Consequently, various populations can be examined to find out whether they are disproportionately affected and if so, what characterizes these populations. A better understanding of the determinants of childhood obesity enables us to tailor prevention and intervention to the specific circumstances of different target groups. Specifically the role of the family in childhood overweight is a growing field of interest (Golan & Weizman, 2001). However, a recent review of Kitzmann, Dalton, & Buscemi (2008) shows that research directly examining the correlation between family factors and child obesity is lacking in the current literature. Indirect evidence was found in research on the association of the socio-economic status of the family (SES) with the occurrence of childhood obesity on the one hand, and research on single indicators of familial stress factors on the other hand.

Earlier studies investigating the relationship between obesity and the socio-economic status of the family yielded inconsistent results depending on different population groups (Parsons, Power, Logan, & Summerbell, 1999; Sobal & Stunkard, 1989). Among adults, SES is one of the most consistent correlates of body weight (Flegal, Harlan, & Landis, 1988). For children, the relationship is less clear. A number of studies have shown repeatedly that children from a lower socio-economic background are at higher risk for overweight and obesity (Danielzik, Cwerwinski-Mast, Dilba, & Müller, 2004; Gray, Byrd, Cossman, Chromiak, Cheek, & Jackson, 2007; Hanson & Chen, 2007; Vieweg, Johnston, Lanier, Fernandez, & Pandurangi, 2007). Other studies could not confirm this (Jones, Nesheim, & Habicht, 1985; Power, Manor, & Matthews, 2003). These conflicting results may have led to the erroneous conclusion that broader, distal family characteristics have limited ability to predict the weight status of young children. Remarkably, former studies on SES have not controlled for the influence of family-related stress factors. Possibly, the conflicting results in studies on SES might be caused by the confounding influence of other more proximal familial factors on childhood obesity.

Research on single indicators of familial factors reveals some interesting findings. Having an overweight mother (Gibson, Byrne, Davis, Blair, Jacoby, & Zubrick, 2007; Hui, Nelson, Yu, Li, & Fok, 2003; Längnase, Mast, & Müller, 2002), living in a single-parent family (Gibson et al., 2007; Hesketh, Crawford, Salmon, Jackson, & Campbell, 2007) and being raised in a low household income (Gray et al., 2007; Langnäse et al., 2002) have been shown to be strongly associated with overweight or childhood obesity in the majority of mainly population-based and cross-sectional studies. Moreover, these correlates were also found to be longitudinal risk factors for childhood overweight, evidenced by the prospective study of Strauss and Knight (1999). Valerio et al. (1998) retrospectively found that 22% of their obese group recalled a stressful life event at the onset of obesity, although Gibson et al. (2007) found no relationship with child adiposity. In some studies, maternal psychopathology was related to children's weight status (Epstein, Klein, & Wisniewski, 1994; Epstein, Myers, & Anderson, 1996; Favaro & Santanastaso, 1995; Zipper et al., 2001), whereas in a more recent study no association with maternal depression could be established (Gibson et al., 2007). These results do not always present a consistent picture. However, unfavourable social factors often do not occur in isolation. As such, examining multiple indicators of familial stress and their associations with childhood obesity seems promising since accumulative exposure to unfavourable family factors may affect health promotion and childhood obesity management in the home environment.

In addition, the specific mechanisms through which family characteristics are associated with childhood obesity remain to be researched thoroughly. It was hypothesized that familial factors and childhood obesity are indirectly linked through the individual and family-shared dietary intake, which was evidenced by Ruxton and Kirk (1996), who recognized socio-demographic variations in eating patterns. In line with previous findings emphasizing the importance of parenting stress experiences when studying family functioning (Abidin, Jenkins, & McGaughey, 1992), we assume that perceived parental stress evoked by unfavourable family factors is an important moderator that merits further attention. As such, this study tests the moderation hypothesis that the experience of parenting stress can have detrimental influences when combined with the accumulation of negative familial factors.

In sum, family characteristics associated with overweight are still studied too fragmentarily and require a study design exploring main influences as well as important interactions of family stress characteristics. Therefore, the present study aims to explore the cross-sectional associations between several familial factors with overweight in childhood. It is hypothesized that families with an overweight child experience more parenting-related stress. The potential family stress factors considered in this study are maternal BMI, family structure, number of children, maternal psychopathology and negative life events. Besides the main effects of these familial factors, we will also explore interaction effects expecting that higher levels of parental reported stress and the presence of one other unfavourable familial factor will more strongly predict overweight in childhood.

Method

Subjects

A total of 197 families with children between 6 and 14 years old ($M = 9.78$; $SD = 1.65$) participated in this study. Of this group, 49% had a normal weight ($n = 97$;

normal weight group). The overweight group consisted of 100 families with a child at risk for overweight or with a child with overweight, according to the CDC guidelines (Centers for Disease Control and Prevention, 2000). The mean adjusted BMI of the overweight group ranged from 121.70 to 215.22% (CDC BMI *z*-scores range from 1.24 to 2.84). The adjusted BMI of the children with normal weight ranged from 75.17 to 119.58% (CDC BMI *z*-scores range from −3.18 to .96).

Procedure

Subject recruitment

The overweight group consisted of 100 families with a child with overweight (between 6 and 14 years old) that was on a waiting list for (1) an inpatient treatment ($n = 13$); (2) an outpatient treatment ($n = 35$) or (3) a school intervention program ($n = 52$). Patients suffering from secondary overweight, caused by endocrinological, chromosomal, hypothalamic diseases or by mental retardation, were excluded from the study.

At the initial contact, 119 parents were asked to participate in the study of which 100 parents agreed (response rate = 84%). A written consent was obtained. Parents filled out the questionnaires under supervision of a trained investigator during the assessment phase preceding the intervention.

Normal weight children of the same age range were recruited via schools with different educational levels. Families with children from as well regular schools, as technical and vocational training schools were asked to participate. For the normal weight group, we achieved a response rate of 100%. All measurements were carried out by a trained investigator during a home visit, following identical standardized guidelines. The trained investigators gave instructions to parents and were at their disposal in case of questions regarding the questionnaire items. They were blind to the hypotheses. When children of this group displayed overweight, they were removed from the study. There were no other exclusion criteria for the normal weight group. The protocol was approved by the Institutional Ethical Committee.

Measures

Anthropometry

Children from the overweight group were weighed on a balance-beam scale. Height was measured with a wall-mounted stadiometer. Children from the normal weight group were measured and weighted during the home visit by the investigator, following standardized instructions. Children from both groups were dressed in light clothing and measured without shoes. Parental weight and height were obtained via self-reported data.

The BMI for the adults (weight/height^2) and the adjusted BMI for the children (Actual BMI/Percentile 50 of BMI for age and gender × 100) were used in the analyses. Children's overweight and obese status was identified in relation to the European body mass index values in 0–21 year olds (Fredriks, van Buuren, Wit, & Verloove-Vanhorick, 2000). We used the widely accepted cut-off for defining overweight (e.g.: A percentage from 120% indicates overweight; Troiano & Flegal, 1998) to assign subjects to the overweight group. In addition, to compare the degree of overweight of the present European sample with US studies on overweight, BMI percentiles and BMI *z*-scores were calculated using a program provided by the Centers for Disease Control and Prevention (CDC) (Centers for Disease Control and Prevention, 2000).

Parental measures

SES and family characteristics were assessed via a self-completed questionnaire consisting of standard questions. Questions included parental highest level of education, employment status, family structure and number of siblings.

The familial SES was calculated using the Hollingshead Index of Social Position (ISP), which includes parents' education and occupation and results in five social position indexes (Hollingshead, 1975). In order to avoid cells with expected count less than five, we recoded the five social position indexes into three social classes (upper, upper middle into 'high', middle into 'middle' and lower middle and lower into 'low').

General Health Questionnaire-28 (GHQ-28; Goldberg & Williams, 1988; Dutch version by Koeter & Ormel, 1991) assesses psychological distress in adults over the preceding four weeks. It yields four subscale scores somatic symptoms, anxiety/insomnia, social dysfunctioning and severe depression and a total score which serves as an index of parental psychological adjustment. Item responses were scored by using a 4-point Likert system (1, 2, 3 and 4). Validity coefficients, sensitivity and

specificity percentages for the GHQ-28 were proved to be high across different studies in several countries (Goldberg et al., 1997).

Parenting Stress Index (PSI; Abidin, 1983; translated version by De Brock, Vermulst, Gerris, & Abidin, 1992) is a parent-report inventory to assess parental experiences of stress in the parenting situation. One hundred and twenty three items are rated by means of a 6-point Likert scale and are divided into 13 subscales, referring to two main domains of parenting stress experience. The 'parent domain' refers to perceived stress regarding family factors and includes seven subscales: Sense of competence (e.g. 'Parenting this child is more difficult for me than I expected'), restricted role (e.g. 'I often get the feeling that my child's needs control my life'), attachment (e.g. 'I find it difficult to understand what my child wants or needs from me'), depression (e.g. 'Sometimes, I am so tired in the morning, that I don't feel like getting up to take care of my children'), parent health (e.g. 'I had more health complaints in the past 6 months than normally'), social isolation (e.g. 'I feel alone and have no friends') and marital relationship (e.g. 'My partner and I often disagree on how to manage our child'). The 'child domain' refers to stress evoked by their child's behaviour and emotions and contains six subscales: Adaptability (e.g. 'My child gets upset in unexpected situations'), acceptability (e.g. 'It is difficult for me to accept my child as it is'), demandingness (e.g. 'Compared to other children, my child demands more of me'), mood, (e.g. 'My child is often bad-tempered') distractibility/hyperactivity (e.g. 'It is very difficult for my child to sit still for a period') and reinforcement to the child (e.g. 'I often get the feeling that my child does not like me'). Finally, a total score of parenting stress (parent domain + child domain) can be calculated. The psychometric qualities of the Dutch version of the PSI are acceptable to good (De Brock et al., 1992). In the present study, Cronbach α were found varying from .45 to .85 for the different subscales. The Cronbach α of both the parent domain and of the child domain were above .90. For the total score of parenting stress we even found an α value of .97.

The life events scale forms a part of the Dutch version of the PSI and assesses whether stressful events occurred within the family during the past 12 months. Responses are recorded in a yes/no format. An aggregated score gives an indication of the amount of life events. There is no psychometric evaluation available.

Analytic plan

All analyses were performed using SPSS for Windows (version 12.0). Overall, 5.47% of questionnaire data was missing. The Little's MCAR test was not significant, indicating that missings can be considered as being completely at random. Missing values were estimated using maximum likelihood estimation (Schafer, 1997) and the expectation maximization algorithm.

Independent sample *t*-tests, χ^2-analyses and a MANOVA on the imputed data were used to assess differences in gender, age, adjusted BMI and familial factors across both groups. Hierarchical regression analyses assessed independent and incremental correlates of children's weight status (DV). The aim was to include a broad range of measures without overloading the analysis with possible redundant variables. All family characteristics were entered in a first block, followed by interaction terms between parenting stress and one of the other family characteristics in a second block.

Data were analysed using the SPSS version 15.0, *p*-values less than 0.05 were considered statistically significant.

Results

Description of the sample

The mean age of the normal weight group was 9.97 (SD = 1.74) and of the overweight group 9.60 (SD = 1.56). In the normal weight group, 51% of the children were male, while in the overweight group 41% of the children were male. Analyses showed no significant gender and age differences between both groups (respectively $\chi^2(1, N = 197) = 1.80$, $p > .05$ and $t(195) = 1.57$, $p > .05$).

The mean adjusted BMI of the overweight group was 151.40% (SD = 20.26) and of the normal weight group 98.55% (SD = 10.81); $t(152) = -22.93$, $p < .001$.

Mothers of the overweight group had a significantly higher mean BMI ($M = 26.13$, SD = 4.40) than mothers of the normal weight group ($M = 22.94$, SD = 3.25); $t(182) = -5.81$, $p < .001$. No significant differences between the two groups were revealed with regard to the SES ($t(195) = -.83$, $p > .05$), the family structure ($\chi^2(1, N = 197) = 2.11$, $p > .05$), the number of children

($\chi^2(3, N = 197) = 3.92$, $p > .05$) and the reported life events ($t(195) = .06$, $p > .05$). Cross tabs showed that the middle social class was most present in both groups. Although not significant, the lower social class was more present in the overweight group, while the higher social class was more common in the comparison group. One child families were twice as common in the overweight sample. Both groups reported on average four significant life events in their family lives during the past year. There were no significant differences in general well being between parents of the overweight and comparison group, as was measured with the GHQ-28 ($F(4,192) = 1.00$, $p > .05$). See also Table 1.

A MANOVA was conducted on the three scores of the PSI (child domain, parent domain and total score of parenting stress). The results indicated a significant multivariate main effect for group, $F(2,194) = 2.95$, $p = .05$; (effect size: partial $\eta^2 = .03$, indicating a small to modest difference). The univariate *F*-tests revealed significant results for the parent domain, $F(1,195) = 5.06$, $p < .05$. Parents from the overweight group reported higher levels of perceived stress evoked by family factors.

Further exploration of the differences on the parent domain revealed significantly higher scores for parents of children with overweight on the following subscales: Sense of competence, $t(195) = -1.92$, $p = .05$; restricted role, $t(195) = -2.07$, $p = .04$; parent depression, $t(193) = -2.17$, $p = .03$ and parent health, $t(188) = -2.27$, $p = .02$. However, taking into account the accumulation of type 1 error, we applied a Bonferroni correction by lowering the significance level to 0.007 (.05/7) or at least 0.01 (.10/7) for all pairs of comparisons (see Shaffer, 1995). After applying the stringent Bonferroni correction, these results lose their significance.

Familial factors in the prediction of a child's weight status

Table 2 summarizes the results of the hierarchical regression analysis in which seven familial factors and six interaction terms between parenting stress and familial factors were entered consecutively to explain variance in children's adjusted BMI. The cumulative variance accounted for by the entire model (R^2cum), as well as the incremental variance accounted for ($R^2\Delta$) and significance level for each block are presented. Familial characteristics accounted for 26.5% of the variance in child's adjusted BMI. This equation was significant, $F(7,180) = 9.25$, $p < .001$. This can be largely attributed to the significant contribution of maternal BMI ($\beta = .50$) and the number of children in the family ($\beta = -.19$). Adding the interaction terms to the equation produced

Table 1 Mean scores and standard deviations on familial characteristics for the overweight group and the comparison group

	Overweight group	Normal weight group	*p*
Maternal BMI	26.13 (4.40)	22.94 (3.25)	.001
ISP			
Low–Middle–High	32%-56%–12%	26%-53%–21%	.23
ISP total-score	42.26 (10.08)	41.06 (10.15)	.41
Family structure			
Intact–Broken	77%–23%	85%-15%	.15
Number of children			.27
1	18%	10%	
2	53%	50%	
3	22%	30%	
≥4	7%	10%	
Life events	4.18 (3.93)	4.23 (6.58)	.95
PSI			
Parent domain	125.71 (40.08)	113.64 (34.94)	.03
Child domain	151.88 (49.80)	144.63 (49.58)	.31
Total parenting stress	277.59 (84.09)	258.27 (78.69)	.10
GHQ – totalscore	49.67 (11.54)	47.34 (9.55)	.12

BMI, body mass index; ISP, index of social position; PSI, parenting stress index; GHQ, General Health Questionnaire; ns, not significant.

Table 2 Hierarchical regression models of familial characteristics on child's adjusted BMI

	B	SE B	β	t
Block 1				
Number of children	−5.62	2.00	−0.19	−2.80*
Family structure	6.22	5.23	0.08	1.19
SES	−0.12	0.21	−0.04	−0.58
Life events	−0.45	0.40	−0.08	−1.14
Maternal BMI	3.70	0.51	0.50	7.21**
Maternal psychopathology	0.08	0.20	0.03	0.37
Total parenting stress	0.02	0.03	0.05	0.71
$R^2\Delta = .27$**				
Block 2				
Parenting stress × number of children	0.02	0.03	0.05	0.61
Parenting stress × family structure	−0.07	0.07	−0.21	−0.94
Parenting stress × SES	0.01	0.01	0.06	0.85
Parenting stress × life events	−0.01	0.01	−0.03	−0.32
Parenting stress × maternal BMI	−0.01	0.01	−0.10	−1.35
Parenting stress × maternal psychopathology	−0.01	0.01	0.06	0.93
$R^2\Delta = .01$				
R^2 cum = .28**				

*$p < .01$; **$p < .001$.

no significant increase in the explained variance over and above familial characteristics.

Discussion

It is generally accepted that family factors are linked to healthy psychosocial development and health maintenance of children and youngsters (Resnick et al., 1997). In addition, in the case of childhood obesity, it can be assumed that children living in an unfavourable home environment will have less access to regular and varied healthy meals and physical activities, which may in turn affect their risk of overweight. However, previous studies, mainly focusing on single predictors of childhood obesity, concluded that familial factors have limited ability to predict children's weight status. Therefore, the present study included multiple familial indicators and examined whether experience of parenting stress might moderate the associations with child's adiposity.

Preliminary comparisons between a randomly selected group of families with overweight and normal-weight children revealed that parents of overweight children experienced more parenting stress. Further exploration showed that this stress was evoked by both characteristics of the parenting process and the parent's personal health status. Higher stress levels concerning their sense of competence, restricted role, health and depressive mood were reported by this group. We should remark that the internal consistency of the PSI scale 'Health' was found to be low (Cronbach's α of .45), as such limiting the validity of this finding. However, also the Dutch psychometric study of the parenting stress index (De Brock et al., 1992) and the American study of Abidin (1983) showed lower α coefficients for this construct. These authors state that this is understandable in light of the small numbers of items these two scales consist of. We also want to remark that, after applying the stringent Bonferroni correction, the latter results at the univariate level lost their significance, and should therefore be interpreted with caution.

The hierarchical regression analysis indicated that maternal BMI was associated more strongly with children's weight status than other familial variables. Having an overweight mother increases the likelihood of being overweight or obese. This is consistent with many previous findings (Gibson et al., 2007; Hui et al., 2003; Strauss & Knight, 1999; Langnäse et al., 2002) and is explained through sharing both genetic and environmental factors. In addition to genetic heritability, several studies have examined the influence of obesigenic environments and found that families with overweight parents have lower levels of physical activity

and unhealthy dietary intakes, relative to normal-weight parents (Davison & Birch, 2002; Wardle, Guthrie, Sanderson, Birch, & Plomin, 2001).

The number of children in the family also appears to predict childhood obesity to a certain extent. This was in line with findings from Hesketh et al. (2007), indicating that children with siblings were less likely to be overweight than children without siblings. This can be explained by specific circumstances characteristic to single-child families compared to households with several children. For example, it has been shown that children without siblings tend to have fewer opportunities to engage in physical activity (Duncan, Duncan, Strycker, & Chaumeton, 2004), as such increasing the risk of overweight.

The finding that other single familial predictors had limited ability to predict childhood obesity might reflect a temporal change, as was suggested by Gibson et al. (2007). As obesity prevalence rates have increased dramatically over the last decade, obesity is widespread and no longer confined to lower background families. Nowadays, all SES groups have easy access to energy-dense foods (Wang, 2001). Both unfavourable familial factors and organizational factors in families of all SES positions lead to the consumption of convenience food, high in fat and low in nutritional values.

Otherwise, children's age group might have influenced the results. Possibly, the children in our sample were too young and a longer exposure over time is required to detect the impact of family characteristics on weight status (Hesketh et al., 2007). The sample consisted of children from 6 to 14 years old and this time span encompasses a developmental shift from a mainly home-oriented dietary intake to a more autonomous food selection. Future research should focus on the developmental and age-related features of family life that may affect the prevalence of obesity across the life span.

The addition of several two-way interactions between parenting stress and other familial variables to the regression model did not contribute to the prediction of child's weight status. This leads us to suggest that parenting stress cannot be considered as a possible mechanism moderating between familial factors and the association with childhood obesity. The hypothesis that familial factors will be of more influence on child's weight status in high stress environments could not be confirmed. Possibly, other familial mechanisms are involved. As the face of families has changed over the past decades, it is reasonable to assume that other familial factors (such as parental working hours, structural variations in family composition, the actual time spent together) might be more related to the occurrence of obesity in children (Hesketh et al., 2007).

Methodological issues may have confounded the results of the linear regression. Holmbeck (1997) states that significant moderator effects may be difficult to detect statistically when samples are relatively homogeneous. Based on a box plot, we discovered that in our sample the presence of unfavourable familial factors was indeed homogeneous; as such all high and low values of the moderator and predictor could not be adequately represented (McClelland & Judd, 1993). Furthermore, Jaccard & Wan (1996) also state that the SEM strategy is preferred when examining moderator effects, especially because regression analyses tend to underestimate the effect size of the interaction term due to measurement error when computing interaction terms. However, the relatively small sample size of the present study did not permit SEM strategies.

Another limitation of this study is the use of a sample consisting only of children with overweight seeking treatment. Given that previous research highlights that this group reports more psychological distress (Braet, Mervielde, & Vandereycken, 1997), our results should not be generalized to the general paediatric overweight population. However, we found one study that examined family characteristics in a treatment-seeking versus a non-treatment-seeking group of overweight children. Interestingly, initial comparisons suggested that the treatment-seeking children came from more socially disadvantaged families with a lower annual income and had mothers with higher BMIs than the non-treatment-seeking children. After controlling for child BMI *z*-score, however, these differences disappeared (Gibson et al., 2007). This is a contraindication for a potential bias introduced by the use of a restricted sample consisting only of children with overweight seeking treatment. Nevertheless, it would be interesting to examine family factors in a more representative sample of youngsters with overweight via a population-based study.

In addition, it would be recommendable to consider the weight status of the siblings besides the status of the index child. This approach would allow to assess within family variability and to combine influences of both the shared and the non-shared environment associated with differential outcomes in siblings.

Do we have to conclude that familial variables have limited ability to predict children's weight status? We agree with Hesketh et al. (2007) that family characteristics are not sufficient in themselves to explain the increased prevalence in childhood overweight. Obesity is widespread and is no longer confined to families in unfavourable home environments. These societal and temporal evolutions merit more attention and should be considered when examining the influence of familial characteristics of specific target groups on the daily lifestyle of families. Finally, the relation between family characteristics and childhood obesity remains an important field of research. More specifically, the hypothesis that parenting stress has a moderating influence on the psychological problems in obese children, rather than the degree of overweight itself, is a valuable research question that merits further attention.

References

Abidin, R. R. (1983). *Parenting stress index: Manual, administration booklet, and research update*. Charlottesville, VA: Pediatric Psychology Press.

Abidin, R. R., Jenkins, C. L., & McGaughey, M. C. (1992). The relationship of early variables to childrens' subsequent behavioural adjustment. *Journal of Clinical Child Psychology*, *21*, 60–69.

Braet, C., Mervielde, I., & Vandereycken, W. (1997). Psychological aspects of childhood obesity. A controlled study in a clinical and non-clinical setting. *Journal of Pediatric Psychology*, *22*, 59–71.

Centers for Disease Control and Prevention. (2000). EpiInfo's Nutrition program, NutStat. Retrieved January 19, 2005, from www.cdc.gov/epiinfo

Danielzik, S., Czerwinski-Mast, M., Langnäse, K., Dilba, B., & Müller, M. J. (2004). Parental overweight, socioeconomic status and high birth weight are the major determinants of overweight and obesity in 5–7 y-old children: Baseline data of the Kiel Obesity Prevention Study (KOPS). *International Journal of Obesity*, *28*, 1494–1502.

Davison, K. K., & Birch, L. L. (2002). Obesigenic families: Parents' physical activity and dietary intake patterns predict girls' risk of overweight. *International Journal of Obesity*, *26*, 1186–1193.

De Brock, A. J. L. L., Vermulst, A. A., Gerris, J. R. M., & Abidin, R. R. (1992). *NOSI: Nijmeegse Ouderlijke Stress Index* (NPSI: Nijmegen Parenting Stress Index) Lisse: Swets & Zeitlinger.

Dietz, W. H. (1998). Health consequences of obesity in youth: Childhood predictors of adult disease. *Pediatrics*, *101*, 518–525.

Duncan, S. C., Duncan, T. E., Struycker, L. A., & Chaumeton, N. R. (2004). A multilevel analysis of sibling physical activity. *Journal of Sport and Exercise Psychology*, *26*, 57–68.

Epstein, L. H., Klein, K. R., & Wisniewski, L. (1994). Child and parent factors that influence psychological problems in obese children. *International Journal of Eating Disorders*, *15*, 151–158.

Epstein, L. H., Myers, M. D., & Anderson, K. (1996). The association of maternal psychopathology and family socioeconomic status with psychological problems in obese children. *Obesity Research*, *4*, 65–74.

Favaro, A., & Santonastaso, P. (1995). Effects of parents' psychological characteristics and eating behaviour on childhood obesity and dietary compliance. *Journal of Psychosomatic Research*, *39*, 145–151.

Finkelstein, E. A., Fiebelkorn, I. C., & Wang, G. J. (2003). National medical spending attributable to overweight and obesity: How much, and who's paying? *Health Affairs*, *22*, 219–226.

Flegal, K. M., Harlan, W. R., & Landis, J. R. (1988). Secular trends in body mass index and skinfold thickness with socioeconomic factors in young adult women. *American Journal of Clinical Nutrition*, *48*, 535–543.

Frederiks, A. M., van Buuren, S., Wit, J. M., & Verloove-Vanhorick, S. P. (2000). Body index measurements in 1996–1997 compared with1980. *Archives of Diseases in Childhood*, *82*, 107–112.

Gibson, L. Y., Byrne, S. M., Davis, E. A., Blair, E., Jacoby, P., & Zubrick, S. R. (2007). The role of family and maternal factors in childhood obesity. *Medical Journal of Australia*, *186*, 591–595.

Golan, M., & Weizman, A. (2001). Familial approach to the treatment of childhood obesity: Conceptual model. *Journal of Nutrition Education*, *33*, 102–107.

Goldberg, D. P., Gater, R., Sartorius, N., Ustun, T. B., Piccineli, M., Gureje, O., et al. (1997). The validity of two versions of the GHQ in the WHO study of mental illness in general health care. *Psychological Medicine*, *27*, 191–197.

Goldberg, D. P., & Williams, P. (1988). *The user's guide to the general health questionnaire*. Windsor: NFER—Nelson.

Gray, V. B., Byrd, S. H., Cossman, J. S., Chromiak, J., Cheek, W. K., & Jackson, G. B. (2007). Family characteristics have limited ability to predict weight status of young children. *Journal of the American Dietetic Association*, *107*, 1204–1209.

Hanson, M. D., & Chen, E. (2007). Socioeconomic status, race and body mass index: The mediating role of physical activity and sedentary behaviors during adolescent. *Journal of Pediatric Psychology*, *32*, 250–259.

Hesketh, K., Crawford, D., Salmon, J., Jackson, M., & Campbell, K. (2007). Associations between family circumstance and weight status of Australian children. *International Journal of Pediatric Obesity*, *2*, 86–96.

Hollingshead, A. B. (1975). *Four factor index of social status*. New Haven, CT: Yale University.

Holmbeck, G. N. (1997). Toward terminological, conceptual, and statistical clarity in the study of mediators and moderators: Examples from the child-clinical and pediatric psychology literatures. *Journal of Consulting and Clinical Psychology*, *65*, 599–610.

Hui, L. L., Nelson, E. A. S., Yu, L. M., Li, A. M., & Fok, T. F. (2003). Risk factors for childhood overweight in 6- to 7-y-old Hong Kong children. *International Journal of Obesity*, *27*, 1411–1418.

Jaccard, J., & Wan, C. K. (1995). Measurement error in the analysis of interaction effects between continuous predictors using multiple regression: Multiple indicator and structural equation approaches. *Psychological Bulletin*, *117*, 348–357.

Jones, D. Y., Nesheim, M. C., & Habicht, J. P. (1985). Influences of child growth associated with poverty in the 1970s: An examination of HANES I and HANES II, cross-sectional US national surveys. *American Journal of Clinical Nutrition*, *42*, 714–724.

Kitzmam, K. M., Dalton, W. T., & Buscemi, J. (2008). Beyond parenting practices: Family context and the treatment of pediatric obenty, *Family Relation, 57,* 13–23.

Koeter, M. W. J., & Ormel, J. (1991). *The general health questionnaire (Dutch version)*. Lisse: Swets & Zeitlinger BV.

Langnäse, K., Mast, M., & Müller, M. J. (2002). Social class differences in overweight of prepubertal children in northwest Germany. *International Journal of Obesity*, *26*, 566–572.

McClelland, G. H., & Judd, C. M. (1993). Statistical difficulties of detecting interactions and moderator effects. *Psychological Bulletin*, *114*, 376–390.

Must, A., & Strauss, R. S. (1999). Risks and consequences of childhood and adolescent obesity. *International Journal of Obesity and Related Metabolic Disorders*, *23*, S2–S11.

Parsons, T. J., Power, C., Logan, S., & Summerbell, C. D. (1999). Childhood predictors of adult obesity: A systematic review. *International Journal of Obesity and Related Metabolic Disorders*, *23*, S1–S107.

Power, C., Manor, O., & Matthews, S. (2003). Child to adult socio economic conditions and obesity in a national cohort. *International Journal of Obesity*, *27*, 1081–1086.

Resnick, M. D., Bearman, P., Blum, R. W., Bauman, K. E., Harris, K. M., Jones, J., et al. (1997). Protecting adolescents from harm: Findings from the National Longitudinal Study on Adolescent Health. *Journal of the American Medical Association*, *27*, 823–830.

Ruxton, C. H. S., & Kirk, T. R. (1996). Relationships between social class, nutrient intake and dietary patterns in Edinburgh schoolchildren. *International Journal of Food Sciences and Nutrition*, *47*, 341–349.

Schafer, J. L. (1997). *Analysis of incomplete multivariate data*. London: Chapman and Hall.

Shaffer, J. P. (1995). Multiple hypothesis testing. *Annual Review of Psychology*, *46*, 561–584.

Sobal, J., & Stunkard, A. J. (1989). Socioeconomic status and obesity: A review of the literature. *Psychological Bulletin*, *105*, 260–275.

Strauss, R. S., & Knight, J. (1999). Influence of the home environment on the development of obesity in children. *Pediatrics*, *103*, e85 – part 1.

Troiano, R. P., & Flegal, K. M. (1998). Overweight children and adolescents: Description, epidemiology and demographics. *Pediatrics*, *101*, 497–504.

Valerio, F. A., Argenziano, A., Esposito-Del Puente, A., Iannucci, M. P., Caputo, G., Alfonsi, L., et al. (1998). Onset of obesity in children through the recall of parents: Relationship to parental obesity and life events. *Journal of Pediatric Endocrinology & Metabolism*, *11*, 63–67.

Vieweg, V. R., Johnston, C. H., Lanier, J. O., Fernandez, A., & Pandurangi, A. K. (2007). Correlation between high risk obesity groups and low socioeconomic status in school children. *Southern Medical Journal*, *100*, 8–13.

Wang, Y. (2001). Cross-national comparison of childhood obesity: The epidemic and the relationship between obesity and socioeconomic status. *International Journal of Epidemiology*, *30*, 1129–1136.

Wardle, J., Guthrie, C., Sanderson, S., Birch, L. L., & Plomin, R. (2001). Food and activity preferences in children of lean and obese parents. *International Journal of Obesity*, *25*, 971–977.

Zipper, E., Vila, G., Dabbas, M., Bertrand, C., Mouren-Simeoni, M. C., Robert, J. J., et al. (2001). Childhood and adolescent obesity, mental disorders and familial psychopathology. *Presse Medicale*, *30*, 1489–1495.