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# Psychological stress and obesity

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**Key words:** Serious life events, Parenting stress, Social support, Parental worries

**Short running title:** Psychological stress and obesity in children

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**Abstract**

**Objective** To examine whether there is a relationship between psychological stress in the family and obesity in 5- to 6-year-old children

**Study design** A total of 7443 Swedish families reported on psychological stress across 4 domains as part of the prospective All Babies in Southeast Sweden-project (ABIS). Domains assessed included serious life events, parenting stress, lack of social support, and parental worries. These variables were summarized in cross-sectional and longitudinal composite measures of psychological stress. Logistic regression models were used to calculate odds ratios for childhood obesity for psychological stress.

**Results** A total of 4.2 % of the children were obese according to age-adjusted international standards. Children from families that reported stress in at least 2 of the 4 domains assessed had significantly higher adjusted odds ratios (OR) for obesity, both cross-sectionally (OR, 2.1; 95% CI, 1.3-3.5,  $P < .01$ ) and longitudinally (OR, 2.6; 95% CI, 1.3-5.4,  $P < .01$ ).

**Conclusion** Psychological stress in the family may be a contributing factor for childhood obesity. This finding underscores how important it is to give children with obesity and their families psychological and social support in addition to recommendations about changing life style. (J Pediatr 2008;153:839-44)

**Abbreviations:**

ABIS: All Babies in Southeast Sweden – project, BMI: body mass index, CI: confidence interval, HPA: hypothalamic-pituitary-adrenal, OR: odds ratio, SD: standard deviation, SE: standard error, SPSQ: Swedish Parenting Stress Questionnaire

## **Introduction**

The recent dramatic increase in childhood obesity has been observed in many countries,<sup>1</sup> including Sweden<sup>2</sup>, has raised concerns about children's health.<sup>1</sup> Several factors, both genetic and environmental, seem to be involved.<sup>3 4</sup> Potential risk factors for childhood obesity include low or high birth weight, parental obesity, sleep deprivation, poor dietary habits, lack of physical activity, and psychosocial stress.<sup>3 4</sup>

Stress measured as a prolonged, increased activity of the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system has been linked to severe health problems in adults, such as metabolic syndrome and visceral obesity.<sup>5</sup> Psychological stress in connection with early serious life events activates the HPA axis in children.<sup>6</sup>

The family's social environment is important for the child's mental and physical health.<sup>7</sup> High levels of parenting stress has been linked to insecure child attachment<sup>8</sup> and parental unresponsiveness<sup>9</sup>, both of which are known to induce psychological stress in the child.

Sufficient social support may reduce the parenting stress or its negative effects.<sup>10, 11</sup> However, parents who experience a lack of social support may have fewer resources to deal with psychological stress in the family. Excessive maternal worries about the child's health may impair the mother - infant relationship<sup>12</sup> and it may be associated with an insecure-dismissive attachment style.<sup>13</sup> Excessive worries about the offspring's health is also part of the criteria for anxiety disorder.<sup>14</sup>

When measuring stress in 1 domain at a time, other factors, which could compensate for or exacerbate the stress measured, may be missed.<sup>15</sup> Especially simultaneous exposure to stress in several domains may be seen as a marker of the stress experienced in the family, and presumably affect the child<sup>7, 16</sup>. In this study, parents' psychological stress was measured across different domains and the additive effect of stress was assessed by summarizing these domains in a composite measure of psychological stress in the family.

The aim of this study was to examine whether there is a relationship between psychological stress in the family and obesity in 5- to 6-year-old children. We hypothesized that children who were exposed to psychological stress in the family would be more likely to be obese.

### **Method**

This study was part of the All Babies in Southeast Sweden-project (ABIS), which aims to study causes of type 1 diabetes mellitus by following a general population cohort from birth to adolescence. The inclusion criterion for ABIS was that the child was born in southeast Sweden between October 1997 and October 1999. During this time, about 21700 children were born in this region and 16070 mothers of these children filled out a questionnaire at birth. Subsequently, parents completed questionnaires when the child was 1 year old (n=11082), 2 to 3 years old (n=8805), and 5 to 6 years old (n=7443; referred to as age 1, age 2, and age 5, respectively) on psychological stress and several health issues concerning themselves and the child. This study is based on data provide by families who participated at age 5 (n=7443), and the data these families provided throughout ABIS (birth: n=7272; age 1: n = 6232; and age 2: n=6105). A total of 5221 families participated at all age points. Questionnaires were given to the accompanying parent when taking the child to the regular health care check-ups at the local well-child clinic. As standard procedure of the regular health care check-ups, the child's weight and height were measured by a nurse. Parents filled out the questionnaires either during the visit at the clinic or later at home. No reminders were used.

Parents received written and oral information and were invited to watch a video film about ABIS before they gave their consent to participate. ABIS was approved by the research

ethics committees of the Faculty of Health Science at Linköping University, Sweden, and of the Medical Faculty at Lund University, Sweden.

Body mass index (BMI) was calculated and classified as obese or non-obese.

Internationally comparable cutoff values for obesity were constructed by Cole et al<sup>17</sup> on the basis of samples from 6 different countries by drawing centile curves through BMI = 30 at age 18 and using these centiles for defining BMI value cutoff points for obesity from age 2 to 18 years for boys and girls.

Four domains on psychological stress were assessed. First, serious life events were assessed at age 2 and age 5 with this yes/no question: “Have you been exposed to something which you perceive as a serious life event since your child’s birth?”. Examples given were death of a relative, serious disease in the family, serious accident in the family, divorce, exposure to violence, and unemployment. Second, parenting stress was assessed with the Swedish Parenting Stress Questionnaire (SPSQ)<sup>11</sup>, which has a good validity and good stability<sup>11</sup>. At age 2, the complete instrument was used. Because of space restrictions 3 (23 items) of the 5 (34 items) original subscales were used at age 5 years: tapping the dimensions incompetence (11 items, eg, “It is more difficult than I expected to raise a child”), spouse relationship problems (5 items, eg, “Since I became a parent I get less support than I expected from my partner”), and role restriction (7 items, eg, “Since I got the child I have hardly any time for myself”), excluding the dimensions social isolation (7 items) and health problems (4 items). On each item, a 6-point Likert-type response scale was used ranging from “strongly disagree” to “strongly agree”. A mean value was calculated when < 6 items were missing. A dichotomized variable was created by using the 95<sup>th</sup> percentile as a cutoff point, defining exposure to parenting stress. Third, lack of social support was assessed with 10 items tapping perceived quality of social support (derived from Crnic et al<sup>10</sup> and used in Östberg and Hagekull.<sup>15</sup>) at age 5. First, parents were asked to quantify, for example “How many times do

you meet your friends/relatives and/or keep in contact via telephone per week?” (The quantitative part of the instrument was not used in this study). Then parents were asked how satisfied they were with this situation on a 5-point Likert-type response scale running from “very satisfied” to “very dissatisfied” for each item. Criterion for inclusion in the statistical analyses was that at least 9 of the 10 qualitative items were answered. Mean values higher than the 95<sup>th</sup> percentile were defined as lack of social support. Fourth, parental worries were assessed with 6 items, each describing a potential risk for the child (that the child falls seriously ill, is harmed, is going to be handicapped, is not going to develop normally, is going to be exposed to abuse, and is not going to survive) at age 2. At age 5, 1 item was added (that the child gets a chronic or serious disease). For each item the parent estimated on a 6-point Likert-type response scale ranging from “very calm” to “very worried” how worried they were that their child might become affected. Mean values for answered items (if 1 or no item was missing) higher than the 95<sup>th</sup> percentile defined exposure to parental worries.

Finally, composite measures of psychological stress were created to estimate the overall amount of stress experienced in the family, by counting the number of times a child was exposed in any of the measured domains (composite measures of this kind have been used in Östberg<sup>9</sup> and Wekerle et al<sup>16</sup>). When a child was not exposed in any of the domains the score for the composite measure was 0. When a child was exposed in at least 2 domains the child was considered to be exposed to high stress in the family. In total, 3 composite measures were created. The composite measure at age 5 counted exposure to serious life events, parenting stress, lack of social support, and parental worries at age 5. The composite measure at age 2 counted exposure to serious life events, parenting stress, and parental worries at age 2. The composite measure over time counted exposure to serious life events, parenting stress, and parental worries, respectively when children were exposed both at age 2 and at age 5.

These background variables were used to adjust the relationship between psychological stress in the family and childhood obesity: children's sex, parents' origin (whether born in Sweden or not), parents' age at their child's birth (4 age groups as defined by the quartiles: for mothers 17 - 26, 27 - 29, 30 - 32, and 33 - 46 years; for fathers 16 - 28, 29 - 31, 32 - 34, and 35 - 66 years), parents' weight status (BMI < 25, BMI 25 - 30, BMI > 30) at age 1, parents' educational level at age 5 (university studies versus no university studies), and marital status at age 5 (living with a partner versus single).

Parenting stress, lack of social support, and parental worries were tested for reliability with Cronbach's alpha. Pearson correlations between age 2 and age 5 were calculated for parenting stress and parental worries, respectively. The relationships between psychological stress variables and childhood obesity were estimated by using logistic regression analyses. Odds ratios (OR) and their 95 % confidence intervals (CI) were used to indicate the strength of the relationship between childhood obesity and psychological stress in the family. ORs were calculated to compare children "exposed" and "not exposed" according to each psychological stress domain and for comparing "not exposed", "exposed in one domain", and "high stress in the family" (ie, exposed in at least 2 domains) for each of the composite measures. Both crude OR and OR adjusted for background variables were calculated. The dependent variable in all analyses was childhood obesity at age 5. Attrition analyses were based on  $\chi^2$  and independent  $t$  tests. As level of statistical significance  $\alpha = 0.05$  was used. Because of internal attrition, the number of subjects in separate analyses may vary depending on the variables included. SPSS software version 15.0 for Windows, Release 15.0.0 (6 September 2006) was used.

## **Results**

The children were between 4.5 years and 6.5 years old when the age 5 questionnaires were completed. A total of 52.1 % were boys, and 47.9 % were girls. Data on the child's age,



sex, weight, and height were available for 6733 children and 4.2 % ( $n = 282$ ) of the children were obese.

Parents reported having experienced a serious life event at age 2 in 23.9 % ( $n = 1444$ ) and at age 5 in 36.3 % ( $n = 2670$ ) of the families.

Parenting stress showed a reliability at age 2 of  $\alpha = 0.89$  (34 items), and at age 5 of  $\alpha = 0.88$  (23 items). At age 2, there was a high correlation between the mean value on the basis of all 34 items and the mean on the basis of the selected 23 items used at age 5 ( $r = 0.96$ ;  $p < 0.001$ ). Furthermore, SPSQ showed stability of parenting stress with time from age 2 to age 5 ( $r = 0.66$ ,  $p < 0.001$ ). The mean for the SPSQ at age 2 was 2.56 (SD = 0.60) and at age 5 was 2.67 (SD = 0.68). The cutoff point at the 95<sup>th</sup> percentile for age 2 was 3.62 and for age 5 it was 3.87.

Lack of social support showed a reliability of  $\alpha = 0.88$  (10 items). The mean for social support was 1.67 (SD = 0.70), and the 95<sup>th</sup> percentile cutoff point was 3.10.

Parental worries showed a reliability of  $\alpha = 0.89$  (6 items) at age 2 and  $\alpha = 0.91$  (7 items) at age 5. The correlation between means at age 2 and age 5 was  $r = 0.59$  ( $p < 0.001$ ). The mean for parental worries at age 2 was 2.53 (SD = 1.18), and at age 5 it was 2.46 (SD = 1.11). The 95<sup>th</sup> percentile cutoff point at age 2 was 4.7, and at age 5 it was 4.55.

Data about regarding the composite measures of psychological stress are summarized in Table I (available at [www.jpeds.com](http://www.jpeds.com)), showing the number of children per score for the composite measure as a total, and by each psychological domain, respectively. Few children were exposed in 3 or 4 domains, and therefore they were grouped together with children who were exposed in 2 domains for the logistic regression analyses. The relationship between psychological stress and childhood obesity is summarized in Table II and models stratified for parental weight are shown in Table III. Relationships between background variables and childhood obesity are summarized in Table IV (available at [www.jpeds.com](http://www.jpeds.com)).

Attrition analyses were performed on the basis of data available from the at-birth questionnaire. Children who participated at age 5 were not significantly different in birth weight ( $t(15990) = 1.30; p = 0.20$ ) or birth length ( $t(15950) = 0.02; p = 0.99$ ), but were born at a slightly older gestational age ( $t(15678) = 2.67; p < 0.01$ ) compared with children who participated at birth but were lost to follow-up at age 5. The mean difference in gestational age was 0.08 (SE = 0.03) weeks. Neither mothers' BMI ( $t(10432) = 0.11; p = 0.92$ ) nor fathers' BMI ( $t(9966) = 1.18; p = 0.24$ ) differed significantly between the 2 groups. Mothers ( $t(14958) = 7.82; p < 0.001$ ) and fathers ( $t(14861) = 4.99; p < 0.001$ ) were significantly older in the group who participated at age 5. However, the mean difference was 0.59 years (SE = 0.08) for mothers and 0.45 years (SE = 0.09) for fathers. Dropping out was neither related to the child's sex ( $\chi^2(1) = 0.31; p = 0.58$ ) nor fathers' education ( $\chi^2(1) = 1.73; p = 0.19$ ), but mothers with no university education ( $\chi^2(1) = 48.70; p < 0.001$ ), and mothers born outside Sweden ( $\chi^2(1) = 26.50; p < 0.001$ ), and fathers born outside Sweden ( $\chi^2(1) = 59.09; p < 0.001$ ) were significantly more likely to drop out. Furthermore, singles ( $\chi^2(1) = 53.11; p < 0.001$ ) and parents who lack social support ( $\chi^2(1) = 6.11; p = 0.01$ ) were significantly more likely to drop out. Experience of serious life events during pregnancy ( $\chi^2(1) = 0.21; p = 0.65$ ) was not related to drop out.

## **Discussion**

Our results suggest a relationship between psychological stress in the family and obesity in 5 to 6 years old children. In particular, significantly higher ORs for the composite measures of psychological stress suggest a relationship between psychological stress in the family and childhood obesity.

Serious life events were related to childhood obesity in this study when background factors were taken into account. Serious life events, such as death of a relative, divorce, or unemployment have earlier been shown to have a strong and lasting impact on family life and

childhood ill-health.<sup>18-20</sup> It is unlikely that all families are affected and react in the same way. However, it is reasonable to believe that most families experience a significant amount of psychological stress during a period of a serious life event. Parenting stress was not related to childhood obesity in this study. However, the cutoff values for exposure to parenting stress (age 2 = 3.62, age 5 = 3.87) were just higher than the theoretical mean of the scale (3.50), which indicate a floor effect. Thus, not all children classified as exposed to parenting stress may actually have been exposed to levels of parenting stress high enough to affect the child. Lack of social support was not associated with childhood obesity in this study. As with parenting stress, the cut-off value used for lack of social support (3.10 compared with a theoretical mean of 2.5) indicate a floor effect. Parental worries were significantly related to childhood obesity. That parents were worried about their obese children may not be surprising because of discussion of negative health consequences of obesity.<sup>1</sup> However, extreme worries about individual children may perhaps be unfounded and could eventually burden the family.

The composite measure of psychological stress, measuring the additive effect of stress across domains, at age 5 showed that high stress in the family was related to childhood obesity at age 5. This cross-sectional finding was supported by the longitudinal finding of a relationship between high stress in the family at age 2 and childhood obesity at age 5. Another longitudinal analysis of the data (the composite measure over time) takes into account stress reported 3 years earlier and stress reported cross-sectionally and shows that high stress in the family over time is also related to childhood obesity. This measure was not significantly related when adjusted for background factors, but showed a trend towards a significant relationship. Taken together, these findings suggest that our estimate of high stress in the family does not reflect a short-term transient stress, but a long-term chronic stress in families that is related to childhood obesity. Correlations for parenting stress and parental worries between age 2 and age 5 support this suggestion. Because psychological stress has been found

to be additive,<sup>7, 16</sup> it is worth noting that the percentage of children with obesity rises with the number of domains in which psychological stress was experienced.

Parental weight at age 1 was used as a baseline for parent weight around their child's birth and showed, compared with other background factors, the strongest relationship to childhood obesity at age 5. However, high stress in the family was related to childhood obesity even when adjusted for parents' weight status. Stratification by parents' weight status suggested that this relationship is found in parents of normal weight and overweight fathers. The results may suggest that psychological stress is a factor contributing to development of childhood obesity.

ABIS as a whole was designed to answer questions about type 1 diabetes mellitus. Thus, the parents were not primed about the possible relationship between psychological stress and weight, which diminishes the risk for reporting biases for psychological stress and weight. Reporting errors about children's weight and height can, of course, not be ruled out, although these values were reported in connection with the regular health care check-ups of the child, at which a nurse took the measurements.

The attrition analyses showed no difference for children's birth weight or birth length, but a significant difference for gestational age. This difference (0.08 weeks or approximately 0.5 days) and the differences found for parents' age (0.59 years) were judged to be too small to be relevant for either weight development or the relationship between psychological stress in the family and obesity.

Parents not born in Sweden, mothers with no university studies, and single parents were less likely to continue in ABIS. Thus, groups at risk of a more exposed socioeconomic or psychosocial situation were under-represented in this study. Furthermore, parents who lacked social support were less likely to continue in ABIS and thus probably were also under-represented. Because we were interested in families with lack of social support, this is a

shortcoming, which perhaps also explains the floor effect found for the social support measure. However, a relationship between psychological stress in the family and childhood obesity was found despite these shortcomings for parents of normal weight and overweight fathers.

Analyses for obese parents failed to show a relationship between psychological stress and childhood obesity. This may be because of the small number of cases available for these analyses. Thus, in this study we cannot conclude whether psychological stress may or may not increase the risk of obesity for children of obese parents.

If psychological stress in the family is a contributing factor in the development or maintenance of obesity, children with obesity may be at risk for a vicious cycle, which may be difficult to break. Therefore, it is important to try to change attitudes towards obesity and to help and support families in which children tend to put on weight, especially if the families experience psychological stress.

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**Table I.** Number of children per score for composite measures of psychological stress as a total and shown per domain

	Score for composite measures of psychological stress				
	0	1	2	3	4
<b>Composite measure at age 5</b>					
n of children	3532	2134	367	64	9
% of children with obesity	3.8	4.1	6.5	7.8	0
n of children exposed according to each domain					
Serious life event		1775	314	58	9
Parenting stress		110	145	60	9
Social support		107	153	53	9
Parental worries		142	122	21	9
<b>Composite measure at age 2</b>					
n of children	3728	1405	158	11	
% of children with obesity	3.7	4.6	8.9	9.1	
n of children exposed according to each domain					
Serious life event		1081	146	11	
Parenting stress		144	91	11	
Parental worries		180	79	11	
<b>Composite measure over time</b>					
n of children	4103	962	50	0	
% of children with obesity	3.9	4.3	12.0		
n of children exposed according to each domain					
Serious life event		815	46	0	
Parenting stress		71	28	0	
Parental worries		76	26	0	

**Table II.** Crude and adjusted odds ratios estimating the relationship between each of the psychological domains, the composite measures, and childhood obesity at age 5

	Crude odds ratios for childhood obesity				Adjusted* odds ratios for childhood obesity			
	n	OR	95%CI	<i>p</i> -value	n	OR	95%CI	<i>p</i> -value
Serious life event at age 5				0.09				0.03
No serious life event	4275	reference			3133	reference		
A serious life event	2403	1.23	0.97 - 1.57		1737	1.42	1.04 - 1.93	
Parenting stress at age 5				0.84				0.88
Not exposed	6252	reference			4564	reference		
Exposed	351	0.95	0.55 - 1.64		255	1.05	0.54 - 2.06	
Lack of social support at age 5				0.81				0.68
Not exposed	6015	reference			4441	reference		
Exposed	340	1.07	0.63 - 1.82		235	1.14	0.60 - 2.17	
Parental worries at age 5				0.02				< 0.01
Not exposed	6228	reference			4584	reference		
Exposed	331	1.69	1.08 - 2.65		210	2.06	1.20 - 3.53	
Composite measure at age 5				0.02				0.01
Not exposed	3532	reference			2645	reference		
Exposed in one domain	2134	1.08	0.82 - 1.42	0.57	1572	1.14	0.81 - 1.61	0.45
High stress in the family	440	1.78	1.17 - 2.69	< 0.01	315	2.12	1.29 - 3.49	< 0.01
Composite measure at age 2				< 0.01				< 0.01
Not exposed	3728	reference			2870	reference		
Exposed in one domain	1405	1.25	0.92 - 1.69	0.15	1050	1.52	1.06 - 2.19	0.02
High stress in the family	169	2.55	1.46 - 4.46	< 0.01	113	2.63	1.28 - 5.39	< 0.01
Composite measure over time				0.02				0.08
Not exposed	4103	reference			3171	reference		
Exposed in one domain	962	1.08	0.76 - 1.54	0.66	718	1.31	0.87 - 1.97	0.20
High stress in the family	50	3.32	1.39 - 7.90	< 0.01	31	3.05	1.00 - 9.32	0.05

\* Odds ratios adjusted for children's sex and parents' origin, age, weight status, education, and marital status.



**Table III.** Data stratified by parents' weight status at age 1 for estimating the relationship between high stress in the family at age 2 and at age 5 and childhood obesity at age 5

Stratification criteria	Crude odds ratios for childhood obesity at age 5				Adjusted* odds ratios for childhood obesity at age 5			
	n	OR	95%CI	p-value	n	OR	95%CI	p-value
<b>Mothers' BMI &lt; 25 at age 1</b>								
Composite measure at age 2				0.01				0.01
Not exposed	2250				2155			
Exposed in one domain	771	1.30	0.75 - 2.24	0.35	729	1.31	0.76 - 2.29	0.33
High stress in the family	82	4.05	1.67 - 9.81	< 0.01	73	4.52	1.81 - 11.30	< 0.01
Composite measure at age 5				0.01				0.02
Not exposed	2102				2014			
Exposed in one domain	1187	1.35	0.84 - 2.16	0.21	1129	1.33	0.82 - 2.17	0.25
High stress in the family	223	2.86	1.48 - 5.52	< 0.01	211	2.71	1.34 - 5.48	0.01
<b>Fathers' BMI &lt; 25 at age 1</b>								
Composite measure at age 2				0.03				0.04
Not exposed	1675				1613			
Exposed in one domain	602	1.24	0.62 - 2.47	0.54	571	1.15	0.56 - 2.36	0.70
High stress in the family	61	4.28	1.45 - 12.65	0.01	53	4.35	1.40 - 13.57	0.01
Composite measure at age 5				0.03				0.07
Not exposed	1592				1528			
Exposed in one domain	874	0.97	0.53 - 1.79	0.92	840	0.92	0.48 - 1.75	0.79
High stress in the family	160	2.74	1.23 - 6.08	0.01	155	2.55	1.07 - 6.05	0.03
<b>Mothers' BMI &gt; 25 and &lt; 30 at age 1</b>								
Composite measure at age 2				0.22				0.14
Not exposed	653				638			
Exposed in one domain	302	1.55	0.93 - 2.58	0.09	288	1.64	0.95 - 2.83	0.07
High stress in the family	32	1.63	0.48 - 5.58	0.44	27	2.17	0.60 - 7.77	0.24
Composite measure at age 5				0.98				0.87
Not exposed	583				567			
Exposed in one domain	415	0.97	0.58 - 1.61	0.91	399	1.07	0.63 - 1.82	0.81
High stress in the family	85	1.06	0.43 - 2.58	0.90	81	1.28	0.51 - 3.25	0.60
<b>Fathers' BMI &gt; 25 and &lt; 30 at age 1</b>								
Composite measure at age 2				0.01				0.01
Not exposed	1184				1145			
Exposed in one domain	443	1.73	1.10 - 2.73	0.02	418	1.81	1.12 - 2.92	0.01
High stress in the family	56	2.67	1.09 - 6.51	0.03	53	3.13	1.25 - 7.83	0.01
Composite measure at age 5				0.01				0.02
Not exposed	1047				1012			
Exposed in one domain	674	1.20	0.77 - 1.87	0.42	642	1.27	0.80 - 2.02	0.31
High stress in the family	156	2.43	1.34 - 4.41	< 0.01	147	2.45	1.30 - 4.63	0.01
<b>Mothers' BMI &gt; 30 at age 1</b>								
Composite measure at age 2				0.92				0.64
Not exposed	202				192			
Exposed in one domain	102	1.18	0.52 - 2.69	0.69	94	1.46	0.57 - 3.76	0.43
High stress in the family	24	0.99	0.21 - 4.57	0.99	21	0.65	0.07 - 5.88	0.71
Composite measure at age 5				0.31				0.22
Not exposed	186				176			
Exposed in one domain	133	1.03	0.46 - 2.32	0.95	126	0.53	0.20 - 1.39	0.20
High stress in the family	46	2.05	0.78 - 5.36	0.14	43	1.50	0.50 - 4.48	0.47
<b>Fathers' BMI &gt; 30 at age 1</b>								
Composite measure at age 2				0.65				0.29
Not exposed	153				144			
Exposed in one domain	74	1.45	0.66 - 3.20	0.36	72	2.04	0.84 - 4.97	0.11
High stress in the family	11	0.00	0.00 - .	1.00	8	0.00	0.00 - .	1.00
Composite measure at age 5				0.34				0.46
Not exposed	139				134			
Exposed in one domain	109	1.42	0.68 - 2.96	0.35	103	1.60	0.72 - 3.55	0.25
High stress in the family	22	0.37	0.05 - 2.91	0.34	17	0.73	0.08 - 6.45	0.77

\* Odds ratios adjusted for children's sex, and parents' origin, age, education, and marital status.

**Table IV.** Crude and adjusted odds ratios estimating the relationship between each of the background variables and childhood obesity at age 5

	Crude odds ratio for childhood obesity				Adjusted* odds ratio for childhood obesity			
	n	OR	95%CI	p-value	n	OR	95%CI	p-value
Sex				0.01				0.15
Boys	3531	reference			2556	reference		
Girls	3202	1.36	1.07 - 1.73		2336	1.25	0.92 - 1.68	
Mothers' origin				0.16				0.37
Born in Sweden	6223	reference			4667	reference		
Born outside Sweden	351	1.40	0.88 - 2.24		225	1.32	0.72 - 2.44	
Fathers' origin				0.02				0.12
Born in Sweden	6216	reference			4649	reference		
Born outside Sweden	350	1.66	1.07 - 2.59		243	1.56	0.89 - 2.75	
Mothers' age**				0.04				0.50
17 to 26	1508	1.63	1.14 - 2.35	0.01	1088	1.04	0.64 - 1.68	0.88
27 to 29	1721	reference			1265	reference		
30 to 32	1595	1.52	1.06 - 2.18	0.02	1214	1.39	0.89 - 2.18	0.15
33 to 46	1732	1.53	1.07 - 2.19	0.02	1325	1.20	0.73 - 1.97	0.47
Fathers' age**				0.37				0.76
16 to 28	1551	1.23	0.87 - 1.74	0.24	1128	1.03	0.64 - 1.66	0.89
29 to 31	1609	reference			1205	reference		
32 to 34	1494	0.94	0.65 - 1.36	0.73	1154	0.82	0.52 - 1.29	0.39
35 to 66	1873	1.17	0.84 - 1.64	0.35	1405	0.99	0.62 - 1.57	0.96
Mothers' weight status				< 0.001				< 0.001
Normal weight	3817	reference			3448	reference		
Overweight	1187	2.71	1.99 - 3.69	< 0.001	1086	2.19	1.57 - 3.06	< 0.001
Obese	401	4.15	2.80 - 6.14	< 0.001	358	2.67	1.71 - 4.15	< 0.001
Fathers' weight status				< 0.001				< 0.001
Normal weight	2844	reference			2682	reference		
Overweight	2042	2.81	2.03 - 3.89	< 0.001	1934	2.70	1.91 - 3.83	< 0.001
Obese	298	6.72	4.34 - 10.39	< 0.001	276	5.44	3.37 - 8.78	< 0.001
Mothers' educational level				< 0.01				1.00
> 1 yr university studies	2682	reference			1998	reference		
< 1 yr university studies	4000	1.49	1.15 - 1.93		2894	1.00	0.71 - 1.40	
Fathers' educational level				< 0.01				0.47
> 1 yr university studies	1775	reference			1303	reference		
< 1 yr university studies	4823	1.55	1.14 - 2.11		3589	1.15	0.78 - 1.70	
Marital status				0.03				0.58
Living with partner	6260	reference			4629	reference		
Single	435	1.58	1.05 - 2.38		263	1.18	0.65 - 2.13	

\* Using all background variables in the same model, not including any of the psychological stress variables.

\*\* Groups were defined by quartiles.