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Stress and social support in normal weight and overweight/obese prepubertal children

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Table of Contents

List of Figures and Tables

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Abstract

Background: Overweight and obesity in children are public health problems. Understanding the risk factors is essential in order to develop effective interventions. Besides the more classical known risk factors, the impact of stress either caused by major life events or by repetitive daily hassles has been proposed to be a more novel important risk factor. Social support is often considered a protective factor concerning the negative effects of stress.

Objectives: This cross-sectional study aimed at comparing normal weight and overweight/obese children with regards to their stress exposure (number of stressful major life events and chronic daily hassles), their stress perception, and the level of social support

Methods: For this part of the study, 50 normal weight and overweight/obese children aged 7 to 10 years old were recruited. Upon arrival, anthropometric measures of children were taken while parents filled out questionnaires about family major life events (including recent life events and early separation), their perceived stress, chronic daily hassles (including socioeconomic status, migrant status, parental worries and parenting practices), and their social support.

Results: There were no group differences with regards to serious life events, recent life events or early separation (all p=NS). In contrast, chronic daily hassles in the form of lower socioeconomic, migrant status and certain unfavourable parenting practices such as corporal punishment occurred more frequently in overweight/obese children than in normal weight children (all $p \leq 0.06$) and parents of overweight/obese children had a tendency to be more worried ($p=0.08$). Finally, there was no difference in social support between the two groups.

Conclusion: In this more clinical sample of children, we found no differences in major life events or social support between normal weight and overweight/obese children, but the latter experienced more chronic daily hassles.
Our results highlight the importance and influence of a child's environment on his weight and thus show that actions should be undertaken to treat childhood obesity on different levels.
Further research is needed to study the interplay of the determinants influencing childhood overweight in a more epidemiological setting.

Keywords: childhood overweight/obesity, major life events, perceived stress, chronic stress, social support

Introduction

The increased prevalence of non-transmissible chronic diseases such as overweight and obesity represents a growing public health concern. The importance of the latter and its complications has been known for several decades in adults. More recently, the problem has also been recognized for childhood obesity.

In the US, the prevalence of childhood obesity, defined as a BMI in the 95th percentile or above, increased almost 4-fold for 6- to 11-year-old children and 3-fold for 12 to 19 year olds between the surveys of 1963–1970 and 1999–2000. For infants (0–23 months), the increase was from 7.2% in 1976–1980 to 11.6%. For 2 to 5 year olds, the increase was from 5 to 13.9% during this time (1). In Europe, the prevalence varies greatly between countries, with a marked difference between southern and northern countries. Overall, the prevalence of overweight and obesity has risen threefold or more between the 1980s and 2005. The annual increase in prevalence was about 0.1% in the 1970, 0.4% in the 1980, and 0.8% in the 1990 to reach up to 2% in some countries in the 2000s as a report of the WHO for the European region showed in 2007. In Switzerland, 4% of children were overweight in 1960 and 18% in 1983 (2). One survey issued in 2013 showed a prevalence of 17% of children being overweight/obese and a tendency for the weight to stabilize or even decrease (3).

Childhood obesity can lead to metabolic diseases, such as an increased cardiovascular risk and an increased risk for type 2 diabetes (previously only known in adults), orthopaedic problems such as flat foot, hyperlordosis or genu valgum, social problems caused by stigma, and psychological problems such as a low self-esteem, bullying, poor emotional feelings or even depression (4). More than 60% of overweight and obese children continue with weight excess and complications into adulthood.

Given the importance of childhood overweight and obesity, understanding their determinants seems to be crucial so as to be able to tackle the issue. Even though the strongest predictor of a child's overweight status is often said to be parental BMI (5), behavioural, biological, social, and psychological risk factors play a role in the development of childhood

overweight and obesity. Besides the more classical risk factors of unbalanced food intake, unstructured eating habits, lack of physical activity and sleep and increased media and screen exposure, exposure to stress has recently been found to play a role. (6–9)

Stress, commonly defined as a body's way to react to a challenge, is a universal condition of human existence and widely accepted as a cause of a large variety of biologic dysfunctions (10). Whereas its effects can be beneficial in the short run, responding to instincts of survival such as the "fight-or-flight paradigm" enabling an animal's response to threats following the activation of the sympathetic nervous system and the hypothalamic-pituitary-adrenal (HPA) axis, its consequences over the long term are harmful. McEwen (10) first defined the notion of "allostatic load" in 1993 as being "the cost of chronic exposure to fluctuating or heightened neural or neuroendocrine response resulting from repeated or chronic environmental challenge that an individual reacts to as being particularly stressful" ((10) p. 2093). Thus, the concept of allostasis describes the active process by which humans adapt to environmental stressors in order to maintain homeostasis and promote survival. Stress occurs when environmental stressors exceed and deregulate the adaptive capacity (allostasis) of an individual, resulting in psychological and physiologic changes. These changes may lead to disturbances in mental and physical health and ultimately promote mental and physical disease such as obesity and metabolic diseases (allostatic load) (11–13). .

According to the allostatic load model, environmental stressors can lead to increased perceived stress which influences behavioral responses (such as lifestyle behaviour) and physiological stress responses through the activation of the sympathetic nervous system and the hypothalamo-pituitary-adrenal (HPA) axis, which then either promote successful coping or allostatic load. These steps and responses vary widely among individuals and are mediated by genetics, developmental influences and past experience (10).

Stress exposure in daily life includes major life events occurring early in life, even before birth or in early childhood, like a child's separation from his parents to events later in life, such as a relative's death or a serious accident. However, it also comprises chronic day-to day hassles like parental worries concerning their child's health that impact on the child's own perception of his surrounding environment and can alter the child's own development (14) poor parenting practices, like low parental involvement (15) as a lack of care and attention are causes of an insecure child attachment and ongoing psychological distress. These stressors usually expand over a longer period of time (16). Socially disadvantaged situations such as low socioeconomic status (with lack of financial and other resources) are also considered a form of chronic repetitive stress, as is parental migrant status with lack of references and cultural belonging. Those daily hassles are now known to activate the cardiovascular, neuroendocrine and immunological response systems (17).

As mentioned before, exposure to stress after a series of life events differs from stress perception, as the latter includes the inner reaction to stress exposure and there is thus a notion of subjectivity, feeling and coping mechanisms involved, such as resilience. The same stress exposure may therefore lead to very different stress perception as a result of an individual's traits on the one hand, and as the outcome of past experiences, the surrounding environment and coping strategies developed on the other.

Sominsky and Spencer (18) showed that acute stress suppressed hunger to enable the body to use its resources to survive the challenge but that it was then followed by a glucocorticoid-stimulation of hunger and eating behaviour. They also mentioned that ongoing psychological stress could lead to chronically stimulated hunger and thus to excessive weight gain. Gundersen et al. (5) showed in his review of 19 studies that psychological stress in the children's environment was almost constantly significantly linked to obesity among children and Jenkins et al. (19) showed how eating was used as a coping mechanism against stress, leading to childhood overweight. The so-called "comfort foods" are "foods whose consumption evokes a psychological

comfortable and pleasurable state for a person" (20). Among children, snack-related comfort foods are particularly common and promote overweight.

The activation of the HPA axis appears to play an important role on weight control behaviours in a way that higher cortisol levels activate eating, enhance the development of visceral obesity and favour the metabolic syndrome, among others through the interaction of glucocorticoids with several appetite-regulating hormones such as ghrelin or leptin (21). Recent studies (7,22) show that childhood stress impacts on the development of the HPA axis in a way that basal cortisol levels are higher and that cortisol production triggered by any stressful event is increased among people who have been through childhood stressful life events compared to a control group. It is still unclear whether a single critical period of child development exists during which the effects of stress have more severe consequences and a higher risk of damaging the stress regulation system. For example, Bosch et al. (23) suggested that the impact of stress on children's physiology is the strongest between age 5-6 and 11-12, with hardly no effect on the stress axis before and after that period. Pesonen (24) reported that separation during childhood does alter stress physiology throughout a person's life. However, evidence has shown that even intrauterine stressful events a mother has gone through during pregnancy can impact negatively on the child's weight in the long run, altering the developing HPA axis, as Pervanidou and Chrousos (7) showed. Although the foetus is somewhat protected from high concentrations of glucocorticoids in the womb thanks to the enzyme inactivating the maternal glucocorticoids into its inactive form, Sominsky and Spencer (18) reported that long-term high concentrations of cortisol may affect developing mechanisms of regulation.

It is recognized that an increased cortisol level caused by chronic stress leads to an impaired insulin sensitivity favouring hyperinsulinemia and atherogenesis, and thus, as a reaction, a higher insulin production. The sympathetic nervous system, which produces the catecholamines epinephrine and norepinephrine from the chromaffin cells, runs parallel to the HPA axis and both interact in response to a trigger. They increase heart rate and stroke volume, lead to vasodilatation in muscles and constriction of blood vessels in the

skin and gut. Epinephrin also stimulates glycogenolysis in the liver, causing an increased serum level of glucose (25).

For successful coping with stressors, social support has been shown to be an essential factor. There is mounting evidence that social support possibly mediates the negative consequences of stress, lowering the perceived hassles a person is facing (26,27). A study carried out in a population of 90 young men by Roy et al. (28) showed that social support after stressful life events shortened the time needed for recovery, thus reducing the allostatic load on the body, although cardiovascular reactivity seemed to be increased as an immediate reaction to stress. The review by Ditzen and Heinrich (26) pointed out that social support was beneficial irrespective of stressors, acting as a buffer by alleviating the negative effects of stress on the physical systems. Among children, Wolff et al. (27) have shown in a population of 4 to 5 year-old children that social support increased the vagal regulatory capacity, an index of flexible vagal responses during various types of stress. This means that under social support, the reaction to stress of the sympathetic nervous system was attenuated.

Thus, there is no doubt that stress is one of the numerous causes of obesity and that causes of stress themselves require further attention.

The current study is part of a randomized study with two populations of overweight (OW)/obese (OB) and normal weight (NW) prepubertal children, studying the effects of physical versus sedentary activity on stress reactivity and food intake. We will neither focus on the differences in stress reactivity or food intake between the obese and normal weight children nor on the effect of physical activity on stress reactivity or food intake, but only on the baseline characteristics of the two groups.

The aims of our study are to (1) compare the number of stressful major life events between a population of normal weight and overweight/obese prepubertal children, to (2) see if chronic “minor” stress in the form of daily hassles is more prevalent among the overweight/obese children, to (3) compare

to what extent stress perception by the children and their parents of these events differs between these two groups, and finally to (4) compare social support in the two groups.

The first hypothesis of our study is that overweight and obese children have experienced a higher number of significant life events including early separation and recent events compared to normal weight children. The secondary hypothesis is that daily hassles such as parental worries, low socioeconomic status, migrant status and unfavourable parenting practices (such as low parental involvement) are more pronounced in overweight and obese children compared to normal weight children. We then assumed that the perceived stress due to life events is higher in overweight/obese children and their parents compared to normal weight children and their parents. Finally, we hypothesized that social support is lower in the families of overweight/obese children compared to normal weight children.

Methods

Participant consent and recruitment

Fifty-two overweight (OW) and obese (OB) children aged between 7 and 10 years were identified by psychologists, dieticians and paediatricians working at the obesity unit of the Children's Hospital Lausanne, as well as by consultants working in the paediatric and emergency departments at the Children's Hospital and the University Hospital in Lausanne (CHUV); their parents agreed to be contacted by the research team. A sample of NW controls was recruited through flyer advertisements and advertisements on the CHUV website. The research team subsequently contacted all parents to verify their interest and checked that their children fulfilled the inclusion criteria: (a) BMI ≥ 90^{th} percentile for the OW/OB or BMI < 90^{th} for the NW according to the WHO-criteria [22]; (b) age between 6.5 and 11 years; (c) absence of known mental disorders such as attention-deficit hyperactivity disorder, autism or chronic medical problems, such as epilepsy and asthma; (d) basic knowledge of French; and (e) child is physically able to perform a running exercise. Upon receipt of the signed consent

form, an appointment was arranged. Participants received a gift voucher of CHF 50 to compensate for their time. The study (clinicaltrials.gov NCT01693926) was approved by the ethics committee of the canton Vaud (protocol 286/2012).

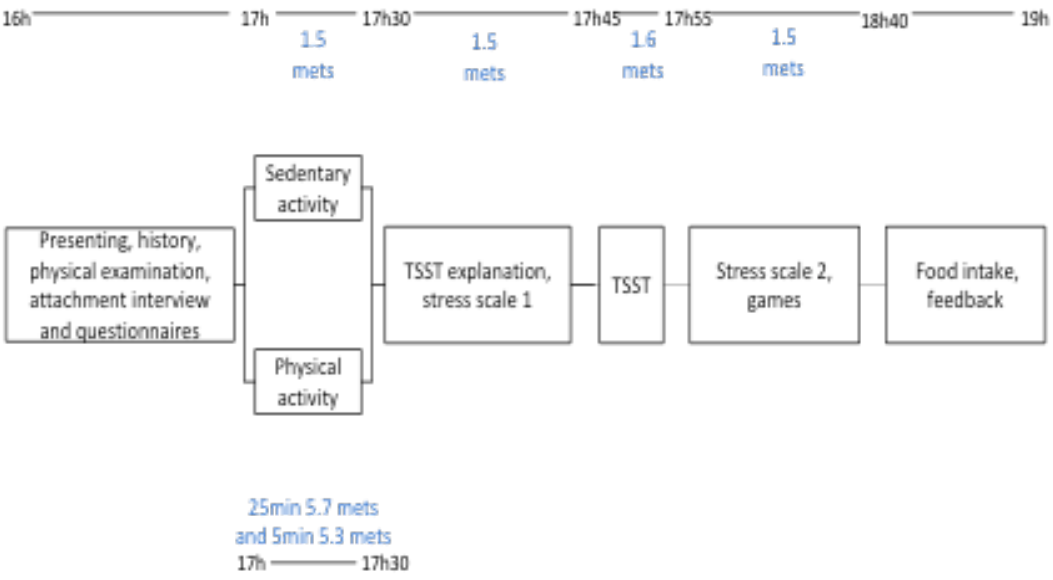
Study design and measures

Study design

Each appointment took place between 4pm and 7pm at the CHUV (see Figure 1 for an overview of the study). On arrival, a physical exam was performed to confirm the OW/OB or NW status. Afterwards, children completed self-report questionnaires with the help of the investigating psychologist, if necessary. After stratification per weight status, children were then randomly assigned to a moderate physical activity or a sedentary activity arm for 30 minutes.

During the same time period, parents completed three questionnaires (see below). Following this, the *Trier Social Test for Children* (TSST-C; stress reactivity testing) was conducted for all children in both arms. At the end of the experiment, children were brought to the kitchen, where they were left alone with food they could eat freely. Then, participants were debriefed and given positive feedback.

Figure 1: Study Design of the afternoon



Measures

Anthropometric measures

Standing height and body weight were measured using standardized procedures and BMI was calculated. Waist circumference was measured by a flexible tape midway between the iliac crest and the lowest border of the rib cage.

Parents' questionnaires

Parents completed a brief demographic questionnaire including their place of birth, educational level, and actual work. Parental migrant status was assigned if at least one parent was born outside of Switzerland and parental socio-economic status was calculated based on both parents' educational level (1=primary education, no professional training to 4=university degree) and on their current profession (1=unqualified employment to 4=managing director or independent academic), with a maximum total score of 4.

Stressful major life events. Parents were given a list of 13 potential major objective life events (death of someone they were close to, serious illness or accident, exposure to violence, history of abuse, unemployment, infirmity, alcohol or drugs, new-born baby younger that 12 months, loss of a pet in the previous 12 months, divorce or separation, house move, major frustration at school) and were asked whether they had been exposed to any of these (choice of life events based on Koch, Obel et al and Pluess et al) (16,29,30). For each major life event, participants had to indicate when it had occurred, whether they, the child or anyone else in their family had been involved, and were asked to rate how much stress this had caused to them as well as their child (Likert scale; 1 = no stress ; 3 = high stress; "perceived stress", (29). They then had the opportunity to add other major life events not included in the list but that they considered meaningful in their child's life. As most of the literature has focused on the last 12 months, we also tried to determine whether a recent event (in the 12 months prior to the experiment date) had a particular impact.

Early separation. Parents were asked whether their child had experienced periods of separation from a close family member before the age of three years. For each separation, they had to indicate when it had taken place, for how long,

what the circumstances of it were and from which family member the child had been separated.

Parental worries were assessed with seven items, each describing a potential risk for the child (child falling seriously ill, being harmed, being disabled, not developing normally, being exposed to abuse, not surviving or developing a chronic or serious illness) (16). Parents had to rate the extent to which they worried about any of these potential events on a 6-point Likert scale ranging from 0 (very calm) to 6 (very worried). Mean values for answered items higher than the 95th percentile defined exposure to parental worries (16).

Parenting practices were assessed using the Alabama Parenting Questionnaire (APQ) (see Appendix). This questionnaire contains 40 items and has seven subscales: 'positive parenting', 'responsible parenting', 'authoritarian parenting', 'inconsistent parenting', 'parental involvement', 'corporal punishment' and 'poor monitoring/supervision'. Parents rated their responses on a 5-point Likert scale from 1 ('never') to 5 ('almost always'). Adequate psychometric properties have been reported. Low parental involvement was operationalized from two APQ subscales: poor supervision/monitoring and low parental involvement.

Social support. Parents' perceived social support was measured providing a list of nine people (mother, father, stepmother, stepfather, brother/sister, friend 1, friend 2, other friends or parents to other children, relatives) and asking who of these and approximately how many times each of them had provided support over the last 12 months (based on Meyer et al) (31) . It was also possible to add other people not included in the list. For each person, they were asked to mention whether he or she had provided help during the past 12 months and if yes, how often. Following this, parents had to rate their satisfaction with the number of people in their social network, and the frequency and quality of help they received.

Data analysis

All analyses were performed using STATA version 12.0 (Stata Corp, College Station, TX, USA). Differences between weight categories (OW/OB vs. NW children) in baseline demographic and anthropometric characteristics as well as

life events, perceived life events or social support were calculated using mixed linear or logistic regression models. When significant, differences were also corrected for repeated measures. All differences are shown as beta-coefficients with 95% confidence intervals and data are presented as mean ± standard deviation, unless stated otherwise.

Results

Baseline sample characteristics

Our final sample consisted of 24 OW/OB (5 OW and 19 OB) and 26 NW children. Table 1 shows the demographic data for the OW/OB and NW groups, which differed with regards to age and anthropometric measures.

Table 1: Baseline Sample Characteristics

	Normal weight (n = 26)	Overweight/obese (n = 24)	*p*
Age (years)	**8.6 ± 0.7**	**9.2 ± 1.3**	**0.04**
Sex (girls/boys)	**13 / 13**	**15 / 9**	**0.4**
Height (cm)	**133.1 ± 6.2**	**140.4 ± 11.7**	**0.008**
Weight (kg)	**28.4 ± 3.7**	**47 ± 10**	**< 0.001**
BMI (kg/m^2)	**16 ± 1.2**	**23.6 ± 3.1**	**< 0.001**
Waist circumference (cm)	**57.6 ± 8.2**	**80.5 ± 9.4**	**< 0.001**

Data are shown as numbers or as mean and standard deviation

Table 2: Life Events and Perceived Stress

	Normal weight (n = 26)	Overweight/obese (n = 24)	*p*
Total number of stressful major life events	**6.1 ± 2.8**	**5.2 ± 1.9**	**0.19**
Occurrence of early separation: Yes/No	**13/13**	**8/16**	**0.2**
Number of recent stressful major life events (past 12 months)	**1 (0-2.3)**	**1 (0-2.0)**	**0.3**
Parent's perceived stress, *	**15.3 ± 1.6**	**11.6 ± 0.9**	**0.05**
Child's perceived stress according to the parent	**13.1 ± 1.3**	**10.3 ± 0.8**	**0.08**

*Data are shown as numbers, mean standard deviation or median and interquartile range, **related to the life event

Table 3: Sociocultural Variables

	Normal weight (n = 26)	Overweight/obese (n = 24)	*p*
Migrant status (yes/no)	**12/14**	**5/19**	**0.06**
Socioeconomic status	**3.0 ± 0.6**	**2.4 ± 0.7**	**0.004**

Data are shown as numbers or mean standard deviation

Table 4: Parenting Practices

	Normal weight (n = 26)	Overweight/obese (n = 24)	*p*
Positive parenting	**4.5 (4.2-4.8)**	**4.5 (4.3-4.8)**	**0.83**
Responsible parenting	**3.8 (3.5-4.0)**	**3.8 (3.7-4.3)**	**0.59**
Authoritarian parenting	**3.7 (3.5-4.0)**	**3.6 (3.0-4.2)**	**0.39**
Inconsistent parenting	**2.3 (2.1-2.8)**	**2.7 (2.2-3.0)**	**0.22**
***Parental involvement**	**4.2 (3.8-4.5)**	**4.2 (3.8-4.5)**	**0.75**
Corporal punishment	**1.75 (1.25-1.75)**	**2 (1.6-2.8)**	**0.0048**
***Poor monitoring/supervision**	**1.2 (1-1.5)**	**1.2 (1-1.8)**	**0.54**

*Data are shown as numbers or as mean and standard deviation, * marker of low parental involvement*

Table 5: Parental Worries

	Normal weight (n = 26)	Overweight/obese (n = 24)	*p*
Total worries	**17.3 ± 7.1**	**21.7 ± 9.8**	**0.08**
Worry of the child falling seriously ill	**2.3 ± 1.4**	**3.1 ± 1.9**	**0.09**
Worry of the child being harmed	**2.9 ± 1.2**	**4.1 ± 1.7**	**0.007**
Worry of the child being disabled	**1.8 ± 1.1**	**2.6 ± 1.8**	**0.09**
Worry of the child not developing normally	**2.0 ± 1.0**	**2.6 ± 1.4**	**0.1**
Worry of the child being exposed to abuse	**3.3 ± 1.5**	**3.5 ± 1.7**	**0.8**

Worry of the child not surviving	**2.4 ± 1.4**	**2.8 ± 2.0**	**0.4**
Worry of the child developing a serious or chronic illness	**2.5 ± 1.4**	**3.0 ± 1.8**	**0.2**

Data are shown as numbers or as mean and standard deviation

Table 6: Social Support

		Normal weight (n = 26)	Overweight/obese (n = 24)	*p*
Degree of satisfaction about the number of people providing help	Unsatisfied:	**0**	**1**	**0.7**
	Not satisfied:	**1**	**0**	
	Moderately satisfied:	**3**	**3**	
	Rather satisfied:	**8**	**7**	
	Very satisfied:	**14**	**12**	
Degree of satisfaction about the frequency of help provided	Unsatisfied:	**0**	**1**	**0.55**
	Not satisfied:	**2**	**2**	
	Moderately satisfied:	**4**	**5**	
	Rather satisfied:	**9**	**4**	
	Very satisfied:	**11**	**12**	
Degree of satisfaction about the quality of help provided	Moderately satisfied:	**2**	**3**	**0.2**
	Rather satisfied:	**5**	**9**	
	Very satisfied:	**19**	**12**	

Data are shown as numbers or as mean and standard deviation

Major life events and stress perception

Number of stressful major life events

There were no significant differences with regards to the number of stressful major life events mentioned by parents between the OW/OB or NW children (all *p*=NS, see table 2).

However, some differences could be observed when the occurrence of one single event was being considered. Thus, the NW children group accounted for more serious illness in the family, death of a relative and events freely mentioned that were not on the list (p= 0.02, 0.04 and p<0.05). These events included for example hospital admission of one family member, psychiatric treatment of the mother, illness of a child's friend and fear of a dog.

Recent stressful major life events

The number of life events occurring to the children within the 12 months prior to the evaluation date did not differ significantly between the OW/OB or NW children (p=0.3).

Early Separation

There were no differences regarding the frequency of early separation in the OW/OB and NW children (p= 0.2).

Perceived stress

The reported perceived stress of the life events for the parent or the child (both estimated by the parents) was higher among parents of NW children when considering their own stress (p=0.05) and showed a tendency to be higher when they had to rate the stress perceived by their children (p=0.08).

Daily hassles

Sociocultural variables

A difference in terms of socioeconomic status of the parents was found between the OW/ OB and NW children groups (p= 0.004) with OW/OB children having a lower socioeconomic status. Furthermore, the children from the OW/OB group had more often migrant parents (p= 0.06, see table 3).

Parenting practices

Out of the 7 different subscales of the parenting practices, only corporal punishment, showed significant difference between the two groups (p= 0.005; after correction for repeated measures: p=0.035, see table 4), with parents of the OW/OB children reporting more corporal punishment.

Parental worries

There was a tendency for parents of OW/OB children to worry more about their children compared with parents of NW children (p = 0.08 for total worries, see table 5). Parents of OW/OB worried more about their child being harmed (p= 0.007; after correction for repeated measures p=0.049) and had a tendency to worry more about their child falling seriously ill or being disabled (for both p= 0.09; correction for repeated measures p=0.63).

Social Support

There were no significant differences regarding the number of people supporting the parents, the frequency/quantity or quality of help (all $p \geq 0.2$, see table 6) between the groups of OW/ OB and NW children.

Discussion

Our study had four aims, which were to compare the number of stressful major life events between the two populations, to see if chronic "minor" stress in the form of daily hassles was more prevalent among the OW/OB children, to compare to what extent stress perception by the children and their parents of these events differed between these two groups, and finally to compare social support in the two groups.

OW/OB children did not experience more stressful major life events than the NW children. Our results showed no difference between the two groups. The normal weight children even seemed to account for more serious cases of illness in the family, death of a relative or events that were considered relevant by the parents but not included in the list and that they mentioned freely, as hospital admission of one family member, psychiatric treatment of the mother, illness of a child's friend or fear of a dog.

Regarding repetitive day-to day stressful hassles, we found a marked difference regarding socially disadvantaged situations with a higher proportion of lower socioeconomic status and more migrant parents among the overweight/obese group. Parenting practices, especially low parental involvement, was not different between the two groups except that the subscale "corporal punishment" was more prevalent in the overweight/obese group.

We found that parents of OW/OB children tended to worry more for their children than parents of NW children. The difference was particularly marked between the two groups about the child being harmed, and parents of OW/OB children also worried more about their child falling seriously ill or being disabled. We found a difference in perceived stress related to the major life events between the two groups, with the parents of the NW children rating higher perceived stress for themselves and a tendency to evaluate higher stress for their children.

No difference was found related to the quantity or quality of social support between the groups.

Major stressful life events

Number of life events

In our study, we did not find that overweight/obese children had experienced a higher number of major life events than the normalweight children. However, the literature shows a link between a high number of life events and obesity. For example, in a population of 5-6 year old children, Koch (16) studied the relationship between the occurrence of psychological stress, classified into 4 domains (serious life events, parenting stress, lack of social support and parental worries), and childhood obesity. He found that a child affected in more than 2 of the domains mentioned before was considered to be exposed to high stress. His measures taken at the age of 2 and 5 years allowed him to find a clear relationship between stressful life events at age 2 and obesity at age 5, which implies that a higher number of events does affect a child's weight stronger. Furthermore, he stated that the long-term effect of a major life event usually acts as a form of serious chronic stressor within the family. Michels et al. (9) studied the relationship between life events and eating patterns in a population of 437 children aged 5 to 12 years; they found that stress related to major life events or daily problems (emotional, peer, conduct and hyperactivity) were associated with unhealthy eating patterns and thus contributed to obesity. Moreover, a cross-sectional study by Pretty et al. showed in a community sample of grade six to eight children that accumulation of 4 or more adverse childhood experiences such as abuse, household dysfunction, and neglect was found to be

independently associated with high BMI and clinical obesity (32). Robbins and Fray (33), in their study published in 1980 suggested that high-arousal or intense emotions may increase food intake. This could be a possible explanation of the pathway linking chronic repetitive daily stress and obesity.

There are several reasons that can account for the differences between our results and the literature. First, the previous studies were mostly performed in an epidemiological setting, such as schools. The population of our study consisted of normal weight children and their parents who were probably more concerned about health than the average, as they volunteered to take part in our study and families of OW/OB children that were in a large part followed in a clinical setting; they could be a selection of families that agreed to deal and cope with their disease and also agreed to participate in such a study. Had we carried out the same study in another context where the families would have been designated, the outcomes could have been different. It is unlikely that our definition of life events based has had an influence on the results, as our list comprises those used in the majority of the other studies on the topic. Another possibility is that there are not necessarily the life events per se that represent risk factors for obesity, but that families with obese children tend in clinical practice to have poorer narratives of their life events, i.e that coping may play a role. We found that parents of NW children reported more freely on additional major life events indeed.

Recent life events

We tried to determine whether OW/OB children had been through more recent life events (that is, in the past 12 months prior to study) than the normal weight children, but no differences were found. Some studies published so far (Coker et al., Koch, Roy et al, Michels et al.)(9,16,28,34) focused on the 12 months before the study; this time frame was often chosen as people may remember recent events much better that more ancient ones, which could account for a stronger impact on their life. On the other hand, serious life events such as serious illness, accident or divorce can be remembered beyond the last 12 months and it could well take a stressful event more than one year to impact

on life habits and to lead to a substantial change in weight. Pretty et al (32) for example took into account all adverse events happening to the children, no matter when they occurred. In their study, Gundersen et al. (5) mentioned that a majority of the studies reviewed considered that a lag of at least 2 years between the occurrence of a stressor and an effect on an increased prevalence of obesity was necessary.

Early separation

We found no difference between the two groups regarding periods of early separation between the child and his parents from birth up to the age of 3. Early separation is thought to cause a period of stress occurring in a time frame where the HPA axis is developing, and is thus more sensitive to changes. The study of Pesonen et al. (24) in a group of 282 adults indeed shows the impact on the developing HPA axis of children separated from their parents during World War II, stating that such a separation could alter the HPA axis still much later in adult life. Thus, the earlier in life stressful life events occur (the period up to age 5 seems to be especially sensitive), the more important their health impact may be, as a permanent biological embedding of developmental processes into regulatory physiological processes may take place ("programming effect")(35,36).

Chronic daily hassles

Kanner (37) was the first to study the importance of chronic repetitive daily hassles, defined as irritating, frustrating or distressing demands that characterize everyday transactions with the environment. In his study, he suggested that this type of stress had more influence on somatic health than did major life events. In a recent study, Garasky et al. (38) showed how family daily stressors impact on a child's weight, with children aged 5 to 11 being particularly sensitive to a lack of cognitive stimulation and emotional support whereas the weight of older ones (12-17 years) is positively correlated with mental and physical health problems and financial strains.

Based on the literature, we selected socially disadvantaged situations, low parental involvement and parental worries concerning a child's health (Ostberg

et al., Vamosi et al., Koch et al., Van Eck and Nicholson) (14–17) as typical chronic day-to day hassles.

Socially disadvantaged situations

The parents of the overweight/obese children had a lower socioeconomic status and had a tendency to be more often migrants, thus confirming that chronic daily hassles play an important role in the development of childhood obesity. There exists a large body of literature that shows a correlation between socioeconomic status and weight, which we could confirm in our current setting. As an example, a study by Lasserre et al. (39) carried out in Switzerland among a large population of children aged 11 to 13 clearly showed a link between both a low socioeconomic status and a foreign nationality with a higher prevalence of overweight among children. The review of Gundersen et al. (5) also confirmed how influential socioeconomic status was on obesity. As explained in a study by O'Dea and Dibley (40) it is very likely that a wide range of sociocultural factors influence the risk of obesity, including typical social determinants of health such as income, education, access to nutritious food, access to and affordability of sporting facilities, health literacy, outdoor environment, and cultural norms of eating, exercising and ideal weight

We can hypothesize that migration plays an important role as migrant parents. Besides an increased poverty, they may lack points of reference concerning their child's education. Moreover, physical activity and eating habits have been shown to be different between migrant and non-migrant families (41,42).

Parental worries

Our results have shown that parents of overweight/obese children tended to worry more for their children that the parents of normal weight children, thus confirming the role of another example of chronic daily hassles. The difference was most pronounced regarding "worries of the child being harmed". Koch (16) found that parental worries were significantly linked to subsequent childhood obesity in a cohort study of 7443 children followed from birth to age 5-6, using the same questions as we did.

Our cross-sectional study does not enable us to study the causality between parental worries and overweight in children; as mentioned before,

stress itself can cause the HPA axis to dysfunction, possibly leading to overweight. However, parental worries can also arise as a consequence of a child's overweight. The fact that the parents were mostly worried about their child being harmed (which might also include "stigmatisation") and not so much about his not surviving or developing a serious or chronic illness could point into that direction. In our specific setting, a selection bias concerning the more "worried" families could also play a role.

Parenting practices

Out of the 7 parenting practices from the Alabama Parenting Questionnaire we studied, we didn't find any difference between the two groups except for corporal punishment, which was more frequent in the OW/OB group. Corporal punishment is based on three items: "You slap your child when you he/she has done something wrong", "You spank your child with your hand when he/she has done something wrong" and "You hit your child with a belt, switch or other object when you he/she has done something wrong".

Childhood maltreatment has shown to be linked with obesity. A recent study by Danese et al. (43) suggested that maltreated children showed leptin deficiency, which then accounted for overweight and obesity. The literature available about corporal punishment in particular and obesity is scarce though.

Two of the 7 subscales (parental involvement and poor monitoring/supervision) are considered markers of low parental involvement. A study by Whitaker et al. (44) has shown indeed that a neglectful parenting style was linked with childhood obesity, whereas corporal punishment has not proven to be correlated with obesity. The review of Gundersen et al. (5) also highlighted the importance of neglect and its link with childhood obesity. It is important to emphasize that we did not investigate "neglect" per se, which is generally more serious, but only tendencies related to different parenting styles.

Whereas parenting practices are behaviours that parents use to socialize their children, a parenting style can be seen as an atmosphere for raising a child (45). Thus, parallels between parenting practices and parenting styles should be drawn with caution. The two subscales of the parenting practices forming low parental involvement (poor monitoring/supervision and low parental

involvement) can be related to higher neglect in the parenting style. The neglectful parenting style shows similarities with that dimension of parenting practices as it is defined low on the demanding/control axis and on the nurturance/responsiveness one. In general however, studies agreed that permissive parenting style described as low on the demanding/control axis as well and high on the nurturance/responsiveness one, was found to be associated with a more obesogenic environment that is more prone to the development of a child's overweight. On the opposite, the literature shows a consensus that authoritative parenting style, defined as both high demanding by the setting of clear rules and limits and high responsive to the child's needs, is the best feeding practice for children and is linked with the fewest overweight children. Tung and Yeh (46) suggested that parenting style seemed to act as a mediator between a child's feeding practice and his weight status. In his review, Sleddens et al. (47) found that an authoritative parenting style was associated with a better lifestyle through more physical activity and more healthy food.

Parents' perceived stress

The perception of a stressor influences the impact it has on health; we also evaluated the perceived stress of these life events from the parents' point of view (10); the parents had to determine how stressful the event had been for both them and their child. We found that parents of NW children perceived the life events as more stressful than the OW/OB group. They also had a tendency to think that their children had perceived higher stress than the parents of OW/OB children. It is difficult to explain why we obtained those results; to our knowledge, no other studies have investigated the topic so far.

Parks et al. (48) have found a positive correlation between the level of chronic stress perceived by parents and their child's overweight, which could be explained through an increased fast food consumption in these households. The chronic stress mentioned in that study was not related to specific events though.

Social support

Surprisingly, we did not find a difference in terms of social support between the two groups, which had been hypothesised as an important protective factor. Literature, however, seems to agree on the benefits of a good

social support for obesity prevention. In their review, Ozbay et al. (49) explain how social support confers resilience to stress that can be seen as a way of balancing the negative effects caused by stress. The review by Gundersen et al. (5) also highlighted the importance of social support in the different studies reviewed. It has also been shown in numerous epidemiological studies that lack of social support has a negative impact on physical health and that, on the opposite, a relationship between good social support and improved mental and physical health has been observed among different populations. In a study among more than 800 adolescents, Cohen et al. (50) suggest that attention should be drawn to the importance of collective efficacy defined as « a combination of both informal social control and social cohesion, and that reflects the willingness of community members to look out for each other and intervene when trouble arises, especially on behalf of the community's youth ». According to him, collective efficacy plays an important role in the regulation of individual-level net energy balance, either through a metabolic pathway (a lower allostatic load), through neighbourhood differences in the physical and social environment, or both. Veitch et al. (51) also suggest that neighbourhood social environment is important in the regulation of weight in children, although the mechanism of it remains to be investigated.

Our results are in line with Koch (16) who also found no impact of a lack of social support on obesity.

It is likely that the population of both groups in our study benefit from a satisfactory social support, reaching thus a plateau. It came out indeed that about half of each group rated the number of people, the frequency of help and quality of help as very satisfying. We can hypothesize that the families taking part in our study did so because they were proactive and knew how to get help from others. Once again, the same study in another setting would maybe show how important social support is. It is also possible that the wrong questions were asked to really quantify social support as studies highlight the importance of the neighbourhood whereas we have focused on members of the family and relatives.

Strengths and limitations

Our study has several limitations. Our sample was rather small and consisted of 50 children, thus limiting statistical power. The fact that families volunteered to take part in our study implies that we reached people who were more worried than the average and could represent a selection bias. Tendencies for social acceptation could also have influenced the families of OW/OB children more. The participating families also probably had no other serious health problems to deal with (inclusion criteria were: absence of known mental disorders such as ADHD, autism or chronic medical problems, such as epilepsy and asthma and the child had to be physically able to perform a running exercise). Finally, it was a cross-sectional study, which implies that no causal conclusions could be drawn.

Conclusion

Despite previous evidence of the link between childhood trauma and childhood overweight/obesity, our study did not find that overweight/obese children experienced a higher number of major life events, more life events during the past 12 months or a more frequent occurrence of early separation. Nevertheless, we found that parental worries are increased among parents to overweight/obese children. The link between perceived stress and obesity requires further investigation.

In line with the literature, we have shown that chronic stress in the form of low socioeconomical status, migration and poor parenting practices is more frequent among overweight/obese children than the normalweight ones. Finally, we have not been able to highlight the importance of social support on a child's weight, as the majority of both populations seemed to rate as satisfactory both the quality and the quantity of support they received.

Our results highlight the importance and influence of a child's environment on his weight and thus show that actions should be undertaken to treat childhood obesity on different levels.

Further research is needed to study the interplay of the various determinants influencing childhood overweight in a more epidemiological setting.

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