Appetite 59 (2012) 762–769

Contents lists available at SciVerse ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research report

Stress, emotional eating behaviour and dietary patterns in children

Nathalie Michels [a,*], Isabelle Sioen [a,b], Caroline Braet [c], Gabriele Eiben [d], Antje Hebestreit [e], Inge Huybrechts [a], Barbara Vanaelst [a,b], Krishna Vyncke [a,b], Stefaan De Henauw [f]

[a] Department of Public Health, Faculty of Medicine and Health Sciences, Ghent University, De Pintelaan 185, 2 Blok A, B-9000 Ghent, Belgium
[b] Research Foundation – Flanders, Egmontstraat 5, B-1000 Brussels, Belgium
[c] Department of Developmental, Personality and Social Psychology, Ghent University, H. Dunantlaan 2, B-9000 Ghent, Belgium
[d] Department of Public Health and Community Medicine, Sahlgrenska Academy, Box 454, University of Gothenburg, 40530 Göteborg, Sweden
[e] BIPS – Institute for Epidemiology and Prevention Research, Bremen, Germany
[f] Department of Health Sciences, Vesalius, University College Ghent, Keramiekstraat 80, B-9000 Ghent, Belgium

ARTICLE INFO

Article history:
Received 8 June 2012
Received in revised form 7 August 2012
Accepted 11 August 2012
Available online 20 August 2012

Keywords:
Children
Stress
Diet
Eating behaviour
Emotional eating

ABSTRACT

Psychological stress has been suggested to change dietary pattern towards more unhealthy choices and as such to contribute to overweight. Emotional eating behaviour could be an underlying mediating mechanism. The interrelationship between stress, emotional eating behaviour and dietary patterns has only rarely been examined in young children. Nevertheless, research in children is pivotal as the foundations of dietary habits are established starting from childhood and may track into adulthood. In 437 children (5–12 years) of the ChiBS study, stress was measured by questionnaires on stressful events, emotions (happy, angry, sad, anxious) and problems (emotional, peer, conduct and hyperactivity). Data were collected on children's emotional eating behaviour and also on dietary patterns: frequency of fatty foods, sweet foods, snacks (fat and sweet), fruit and vegetables. Stressful events, negative emotions and problems were positively associated with emotional eating. Positive associations were observed between problems and both sweet and fatty foods consumption. Negative associations were observed between events and fruit and vegetables consumption. Overall, stress was associated with emotional eating and a more unhealthy dietary pattern and could thus contribute to the development of overweight, also in children. Nevertheless, emotional eating behaviour was not observed to mediate the stress–diet relation.
© 2012 Elsevier Ltd. All rights reserved.

Introduction

The importance of a healthy diet is widely accepted. More specifically, dietary guidelines are formulated in the prevention of obesity with a focus on high intakes of fruit and vegetables and low intake of energy dense foods like those high in fat and sugar (World Health Organization, 2003). The foundations of dietary habits are established from the ages of 3–4 years old (Singer, Moore, Garrahie, & Ellison, 1995) and may track into adolescence and adulthood (Mikkila, Rasanen, Raitakari, Pietinen, & Viikari, 2005; Wang, Bentley, Zhai, & Popkin, 2002).

An overall healthy diet consists of both a balanced food and nutrient composition as well as a balanced eating behaviour. A balanced eating behaviour comprises eating when feeling hungry, at regular moments to allow physiological growth and energy expenditure. However, a trend of eating in the absence of hunger and intermittent snacking is increasingly observed in the eating pattern in Western society. This unhealthy eating behaviour is related with unfavourable outcomes (unbalanced intake with too much fat and sugar leading to overweight in genetic at risk groups), making it pivotal to study its determinants.

Stress has been associated both with unhealthy emotional eating behaviour and an imbalanced dietary pattern (Adam & Epel, 2007; Dallman et al., 2003; Macht, 2008). However, several research gaps remain unresolved. For example it is relevant to test if stress is related with specific indices of food intake like higher consumption of fatty foods, sweet foods or both (e.g. snacks) and whether emotional eating can be seen as the mechanism underlying the assumed link between stress and an imbalanced dietary pattern. After all, emotional eating is hypothesized as a way of avoidant stress coping, eating induced stress reduction or because of the reward feelings associated with the food (Adam & Epel, 2007; Dallman et al., 2003).

Epidemiological research investigating the influence of stress on children's diet is rather scarce and has mostly been performed in small samples, among adolescents, in laboratory conditions or focused on only one aspect of stress and mostly with indirect measures of imbalanced eating (e.g. increase in weight). As far as we know, only one study in children has included both a specific naturalistic stress measure and a direct measure of the individual's dietary pattern (Jenkins, Rew, & Sternglanz, 2005).

* Corresponding author.
E-mail address: Nathalie.michels@ugent.be (N. Michels).

0195-6663/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.appet.2012.08.010

Therefore, this study aims to fill this research gap by investigating the relationship between several stress measures, emotional eating behaviour and dietary patterns (sweet foods, fatty foods, snacks but also fruit and vegetables) in a sample of preadolescent children. Furthermore, the possible mediation effect of emotional eating behaviour will be tested. Especially in young children studying the role of stress on dietary intake is challenging as parents still highly control their child's diet, while at the same time children already start to develop their own preferences.

Methods

Participants and general procedures

The subjects were 437 Belgian children (49.9% boys) between 5 and 12 years old participating in the ChiBS study (Children's Body composition and Stress) in 2011. The ChiBS study examines stress and the relationship between stress and body composition development in primary school children. All children from the first to fourth year of primary schools in the Belgian city Aalter (in the northern, Dutch-speaking part of Belgium) were invited via the school to enter the study for the baseline stress measurements in 2010. The final purpose was to follow them up during 2 years, finally covering all years of primary school (first to sixth year). In 2011, the children of the baseline study were re-invited, resulting in a participation number of 453 children. Because of some incomplete questionnaires, only 437 children were included for this paper. Detailed aims, design, methods, population and participation characteristics were described elsewhere (Michels et al., 2012). The study was conducted according to the guidelines laid down in the Declaration of Helsinki and the project protocol was approved by the Ethics Committee of the Ghent University Hospital. Parents gave their written informed consent.

Parents and their children were invited for an individual appointment at the local municipal sports park (Aalter, Flanders, Belgium). Children had to fill in questionnaires on stress and on their emotional eating behaviour with assistance of a trained researcher. Parents had to fill in a general questionnaire on demographic characteristics, a questionnaire on their child's strengths and difficulties and their child's dietary patterns. Furthermore, children were measured for anthropometrics.

Questionnaires on children's stress: problems, emotions, life events and coping

Stress arises when the demands of a situation exceed an individual's ability to cope and resolve the problem, resulting in emotional, behavioural and cognitive disturbances (McCance, Forshee, & Shelby, 2006). Besides life events, which are assumed to profoundly affect someone's life, daily annoyances and minor hassles are also seen as an important stressor (Kanner, Coyne, Schaefer, & Lazarus, 1981). However, some events can have greater impact than others. Therefore, stress is for research purposes often operationalized on the symptom level by measuring (a) the daily problems that someone is reporting or (b) the daily emotions someone is feeling or (c) the way someone is handling the problems and feelings.

Problems

Parents were asked to complete the 'Strengths and Difficulties Questionnaire' (SDQ) (Goodman, 1997), reporting the problems of their child over the past 6 months (reliability ICC = 0.80; concurrent validity $r = 0.70$). For each of the 25 statements, parents could answer: 'not true' (0), 'somewhat true' (1) and 'certainly true' (2). The statements were divided in five subscales of five items each: emotional problems, conduct problems, hyperactivity problems, peer problems and prosocial behaviour. Higher scores on the prosocial behaviour subscale reflect strengths, whereas higher scores on the other four subscales reflect difficulties.

Life events

The 'Coddington Life Events Scale' for children (CLES-C) (Coddington, 1972) was used to identify potential physical and mental health problems arising from psychological causalities (reliability $r = 0.69$, construct validity = 0.45). This validated 36-item questionnaire measured the self-reported frequency and timing of neutral and negative events in the last year relevant for this age group and resulted in a children's 'life change units' score for the time periods 0–3, 0–6, 0–9 and 0–12 months ago. In this paper, only the negative event score for the last 6 months was used as the problems were also recorded for this time period.

Daily events: hassles and uplifts

The children's daily hassles (CHS) and daily uplifts (CUS) scales of Kanner et al. (1981) contain 25 hassles and 25 uplifts, respectively (internal consistency: Cronbach's alpha = 0.87). Hassles refer to irritating, frustrating or distressing demands that characterize everyday transactions with the environment. Uplifts refer to positive experiences such as the joy derived from friendship, relief at hearing good news and so on. Children were asked to indicate which hassles and uplifts occurred during the last month. Furthermore, they were asked to rate whether they felt 'not bad' (2 points), 'sort of bad' (3 points), or 'very bad' (4 points) as a result of the hassle and whether they felt 'OK' (2 points), 'sort of good' (3 points) or 'very good' (4 points) as a result of the uplift. An intensity score was used for the hassles (=severity sum of the indicated events) and a frequency score for the uplifts (=amount of events).

Emotions

Children had to indicate on a Likert-scale how they felt recently. The feelings happiness, anger, sadness and anxiety were rated from 0 'not at all' to 10 'very strong' as was done by Zimmer-Gembeck, Lees, Bradley, and Skinner (2009). To help the children understand these distinct feelings, four pictures of a social skills training game for very young children were displayed next to the question (one picture for each emotion) (Dupondt, 1992). These basic emotions are already understandable during infancy (Flavell, 1999) and can as such uncomplicatedly be used in our age-group.

Coping

The children were asked what they usually do when confronted with problems or when they are upset using an eight item-questionnaire, with 'never' (0), 'sometimes' (1) or 'often' (2) as response alternatives. This questionnaire was previously used in the CASE-study (Child and Adolescent Self-harm in Europe) (Madge et al., 2008) and translated into Dutch and substantially pilot-tested for a population of Belgian adolescents (Portzky, De Wilde, & van Heeringen, 2008). The answers were classified as emotion- versus problem-focused coping, based on the transactional model of Folkman and Lazarus (1986). Emotion-focused coping is aimed at regulating emotional stress while problem-focused coping deals with the problem and makes changes in the disturbed and stress-inducing person-environment relationship. A coping index was calculated as "problem-focused coping minus emotion-focused coping", with positive values representing more problem-focused coping.

Questionnaires on children's emotional eating behaviour and dietary patterns

Emotional eating behaviour: children's report

In the Dutch Eating Behaviour Questionnaire (DEBQ), a 33-item questionnaire, three types of eating behaviour can be identified (van Strien, Frijters, Bergers, & Defares, 1986). For this study only emotional eating (eating in response to negative emotions) will be considered. Response alternatives were 'never' (1), 'almost never' (2), 'sometimes' (3), 'often' (4) or 'very often' (5). In a pilot study, the phrasing of the original DEBQ was slightly adapted, without modifying the content, to enhance the children's comprehension. The different subscales revealed a s factor structure, satisfying internal consistency (Cronbach's alpha = 0.77–0.91) and a good test–retest reliability (r = 0.87–0.90) (Braet et al., 2007, 2008).

Dietary patterns: parental report

The Children's Eating Habits Questionnaire – Food Frequency Questionnaire (FFQ) is a screening instrument to investigate food consumption frequency associated with overweight, obesity and general health in children. The 43 item-containing FFQ section was developed and reproducibility (r = 0.32–0.76 for separate items) was tested in the IDEFICS project (Lanfer et al., 2011). Parents were asked to report on the frequency of their child's consumption of selected food items in a typical week during the preceding 4 weeks using the following response options: 'never/less than once a week' (0), '1–3 times a week' (2), '4–6 times a week' (5), '1 time per day' (7), '2 times per day' (14), '3 times per day' (21), '4 or more times per day' (30) or 'I have no idea'. Frequencies of intake were assessed without quantifying portion sizes and the frequency categories were converted to consumption frequency per week. To identify dietary patterns, four 'food indices' on dietary pattern were calculated by summing up the frequency of separate food items: a food index for 'sweet foods' (sweet drinks, sweet sandwich filling, sweet breakfast cereals, sweetened dairy, sweet snacks), 'fatty foods' (fried potatoes, high fat sandwich filling, high fat dairy, sauces, cheese, fat meat preparations, butter, high fat snacks), 'snacks' (chocolate and chocolate bars, candy, biscuits, cake, ice-cream, chips, savoury pastries) and also a healthy food index for 'fruit and vegetables' (fruit, freshly squeezed fruit juice, vegetables) was used.

Socio-economic status

The highest self-reported educational qualification of both parents was assessed according to the International Standard Classification of Education (ISCED) (UNESCO, 2010). The maximal ISCED level of the parents was considered as a proxy for socioeconomic status. Due to the low prevalence of the lowest education levels, the levels were aggregated in a low (1 to 4) and a high (5 and 6) education level.

Body composition

Children's body fat percentage (BF%) was measured by air-displacement plethysmography (BOPOD®, Life Measurement Inc, United Kingdom) using standardized procedures (McCrory, Gomez, Bernauer, & Mole, 1995). This method is currently considered a good reference technique for body composition measurements with a quick, comfortable, automated, non-invasive and safe measurement process, making it feasible in children. Thoracic gas volume was predicted by the software with a validated child-specific equation, and fat mass (FM), fat-free mass (FFM) and BF% were calculated using the equation of Wells (Wells et al., 2010).

Statistical methods

Analyses were done using PASW Statistical Program version 19.0 (SPSS Inc, IBM, IL, USA). The two-sided level of significance was set at <0.05.

To reduce multicollinearity and the amount of analyses, principal component analysis on the stress questionnaires (problems, emotions, life events, daily events and coping) was done using promax rotation. The Keiser–Meyer–Olkin Measure and the significant Barlett's test of sphericity suggested that the data were amenable for this analysis. The stress questionnaire data was transformed in z-scores before inclusion in the analysis. Based on the screeplot, a three factor structure was chosen. These three factors will be used in all further analyses instead of the separate questionnaire responses.

The association between stress and emotional eating behaviour and dietary patterns (by four food indices) was analysed using Spearman correlations. A mediation model for emotional eating in the relation stress versus dietary patterns was tested. A first set of regression analyses was done using the food index as dependent variable (either frequency of sweet foods, fatty foods, snacks or fruit and vegetables). A second set of analyses tried to predict emotional eating by stress factors. Mutual interactions were checked. Analyses were corrected for age, sex, socioeconomic status and BF%. According to Baron and Kenny (1986), mediation is present when the following conditions are met: (1) the independent variable (stress factors) significantly predicts the mediator (emotional eating), (2) the independent variable (stress factors) significantly predicts the dependent variable (food indices), (3) the mediator (emotional eating) significantly predicts the dependent variable (food indices) and (4) the relationship between the independent variable (stress factors) and the dependent variable (food indices) should be significantly reduced after controlling for the mediator (emotional eating). The significance of this fourth (and indirect) effect was tested using the Sobel test (Sobel, 1982). Furthermore, this indirect effect was also tested nonparametrically by bootstrapping (using 10,000 samples) (Preacher & Hayes, 2004).

Results

Descriptive data

As mentioned before, the principal component analysis resulted in a three factor structure for stressors. The first factor (called 'Problems') was positively affected by conduct problems, hyperactivity, peer problems and emotional problems and negatively by prosocial behaviour. The second factor (called 'Negative emotions') was positively affected by sadness, anger, anxiety and negatively by happiness. The third factor (called 'Events') was positively affected by daily uplifts, daily hassles and negative events during last 6 months. These three factors will further be used as stress parameters.

Descriptive data on our child population is given in Table 1. Boys and girls were equally distributed in our sample. No sex differences were seen in emotional eating behaviour measured by the DEBQ or in dietary patterns measured by the FFQ. Boys reported more problems (hyperactivity problems and total problems) and negative life events the last 6 months, while they had lower scores on anxiety and prosocial behaviour.

Correlations

Table 2 shows the correlations between stress parameters, emotional eating behaviour and dietary patterns. The Problems and

Table 1
Descriptive statistics of the 437 participating children.

	Boys $N = 218$		Girls $N = 219$		Sex difference (p)
	Median	IQR	Median	IQR	
Confounders					
Age (years)	8.96	7.80–10.09	9.02	7.79–9.99	0.606
Fat percentage (%)	16.57	13.79–20.52	20.88	16.72–26.83	<0.001*
Socioeconomic status[a] (%high)	55.07%		51.89%		0.557
Stress: raw questionnaire data					
Strengths and Difficulties scores					
Emotional problems (0–10)	2	1–4	2	1–4	0.068
Conduct problems (0–10)	1	0–2	1	0–2	0.083
Hyperactive problems (0–10)	3	2–6	2	1–4	<0.001*
Peer problems (0–10)	1	0–2	1	0–2	0.687
Prosocial behaviour (0–10)	9	7–10	9	9–10	0.002*
Emotion scores					
Happy (0–10)	8	6–9	8	6–10	0.637
Angry (0–10)	2	1–3	2	1–4	0.962
Sad (0–10)	2	0–4	2	0–4	0.495
Anxious (0–10)	0	0–2	1	0–3	0.006*
Life and daily events					
Negative event score last 6 months	34	0–80	0	0–56	0.014*
Daily intense hassles (0–100)	42	28–54	41	27–55	0.735
Daily uplifts (0–25)	23	19–24	22	19–24	0.500
Coping					
Problem versus emotional coping (−10–10)	2	0–3.67	2	0.67–4.00	0.088
Stress: summarizing factors					
Factor 1: Problems (z-score)	−0.07	−0.65–0.75	−0.29	−0.87–0.38	0.002*
Factor 2: Negative emotions (z-score)	−0.29	−0.75–0.37	0.01	−0.74–0.86	0.051
Factor 3: Events (z-score)	0.16	−0.44–0.72	0.01	−0.61–0.67	0.255
Eating behaviour (DEBQ)					
Emotional eating (1–5)	1.92	1.38–2.50	1.92	1.46–2.38	0.811
Dietary pattern					
Sweet food frequency (times/week)	29	22–39	27	20–36	0.277
Fatty food frequency (times/week)	25	18–33	25	19–32	0.852
Snack frequency (times/week)	9	6–14	9	6–13	0.473
Fruit and vegetables frequency (times/week)	14	11–19	14	10–19	0.088

* $p < 0.05$.
[a] Based on maximal parental education: high = tertiary or higher education, DEBQ = Dutch Eating Behaviour Questionnaire; IQR = interquartile range.

Events factor were positively correlated with emotional eating. Problem-focused coping was not associated with emotional eating. The sweet and fatty food indices were positively correlated with Problems and the fruit and vegetables food index negatively with Events.

Mediation of emotional eating behaviour in the stress – dietary patterns relation

Tables 3 and 4 present the regression analyses for dietary patterns and emotional eating behaviour as dependent variables respectively. No interaction effect of stress and emotional eating behaviour was detected. Problems, Negative emotions and Events were positive predictors for emotional eating. These associations differed between boys and girls, with Problems being only significant in girls, Emotions only in boys and Events in both sexes. Children with more Problems had a higher sweet and fatty food index, while children with more Events had a lower fruit and vegetables food index. After correction for emotional eating behaviour, significances remained. Stratified by sex, these stress–dietary patterns relations remained significant for girls, but not for boys (data not shown). Yet, emotional eating behaviour was no significant predictor for dietary patterns, even not after stratification into two age groups (data not shown). Furthermore, no age interactions were seen for the analyses in Tables 3 and 4.

Figure 1 illustrates the possible mediation models based on the regression analyses for which at least two of the four conditions were met. In all the models, stress (Problems and Events) was a significant predictor for dietary patterns. Furthermore, the path between stress (Problems and Events) and emotional eating was also significant. Nevertheless, no relationship was found between emotional eating and dietary patterns. Also, the Sobel test and the bootstrapping of the indirect effect indicated no mediation activity of self-reported emotional eating in the relationship between stress and dietary patterns.

Discussion

This study has shown that stress in children (operationalized in three variables after PCA analyses on several stress-related questionnaires) was associated with emotional eating. Moreover, stress was also associated with an unhealthier dietary pattern (higher consumption frequency of fatty foods, sweet foods, and lower consumption frequency of fruit and vegetables). Nevertheless, emotional eating behaviour did not mediate the stress – dietary patterns relationship as emotional eating behaviour was not associated with the dietary patterns.

Stress and dietary patterns

Overall, stressed children had an unhealthier diet. The stress factor Problems showed the strongest association with the child's dietary patterns, especially when examining the sweet food index and the fat food index. Furthermore, children with a higher score

Table 2
Correlations between stress parameters (both separate items and summarizing factors), emotional eating behaviour and dietary patterns.

		Stress parameters														
		Strengths and Difficulties Questionnaire					Emotions				Life events	Daily events		Coping	Summarizing factors out of principal components analysis		
		Emotional problems	Conduct problems	Hyperactivity problems	Peer problems	Social behaviour	Happy	Angry	Sad	Anxious	6 month events	Hassles	Uplifts	Coping index[a]	Factor 1 Problems	Factor 2 Emotions	Factor 3 Events
Emotional eating	*r*	**0.142****	0.089	**0.130****	−0.025	−0.042	−0.068	0.025	0.051	0.012	0.008	**0.292****	**0.104***	−0.014	**0.119***	0.094	**0.207****
Dietary patterns: food consumption frequency																	
Sweet foods	*r*	**0.107***	**0.108***	**0.151****	0.084	**−0.118***	−0.083	0.005	0.057	0.001	−0.025	0.033	−0.079	−0.078	**0.183****	0.054	0.002
Fatty foods	*r*	**0.101***	0.068	0.034	0.065	**−0.104***	−0.069	−0.036	0.072	−0.010	−0.019	−0.037	**−0.122***	−0.090	**0.117***	0.049	−0.092
Snacks	*r*	0.017	0.027	−0.010	−0.020	−0.085	−0.001	−0.044	−0.008	−0.039	−0.067	0.016	−0.084	−0.001	0.015	−0.054	−0.035
Fruit and vegetables	*r*	0.053	−0.021	**−0.122***	0.008	0.062	0.055	0.020	−0.043	−0.016	−0.092	−0.055	−0.041	0.022	−0.023	−0.012	**−0.112***

Significant correlations are shown in bold.
r = Spearman correlation coefficient.
* $p < 0.05$.
** $p < 0.01$.
[a] Problem-focused coping minus emotion-focused coping.

on the second stress factor Events had a lower fruit and vegetables food index. The third stress factor Negative emotions was not related with any of the food indices.

In literature, this stress–dietary patterns relationship has been indicated before in adolescents: adolescent's perceived stress has been associated with more fatty foods, less fruit and vegetables and more snacks (Cartwright et al., 2003) and lower overall diet quality (De Vriendt et al., 2011) and problem behaviour has also previously been associated with higher fatty food intake (Simon, Wardle, Jarvis, Steggles, & Cartwright, 2003). This supports the theory of stress induced eating of 'comfort foods' as either a stress coping strategy (escape) or because of the eating-induced stress reduction and associated reward feelings (Adam & Epel, 2007; Dallman et al., 2003). Nevertheless, this has seldom been studied in young children. To our knowledge, only one study in preadolescents demonstrated more snacking with more perceived stress (Jenkins et al., 2005) and one study showed more snacking in response to laboratory stressors (Roemmich, Wright, & Epstein, 2002). Our findings add to this knowledge on the relationship between stress and an unhealthier diet, thereby differentiating for more food indices and more stress variables.

In stress-induced changes of eating patterns, some variability across stress factors may exist. After all, the arousal (depression versus anger and fear), intensity (high versus low) and valence (positive versus negative) of emotions or stressors may influence emotional eating behaviour differentially, complicating the stress–diet research (Macht, 2008). Differences may also exist in diffuse versus clear-cut stress. In the case of diffuse or vague stress like daily events, people cannot allocate the stress or emotion and will be more prone to use eating as a way of coping. On the other hand, well-defined stress like strong emotions might not stimulate or even lower the motivation to eat (Macht, 2008). Finally, apart from changes in dietary choice, also changes in overall food intake during stress may occur (Macht, 2008), but this was not tested in our study.

Stress and emotional eating behaviour

Stress–emotional eating behaviour associations were positively significant for all three stress concepts. Indeed, children's and adolescents' negative emotions (depression and anxiety) and problems have been associated with emotional eating in literature (Braet & Van Strien, 1997; Goossens, Braet, Van Vlierberghe, & Mels, 2009; Nguyen-Rodriguez, McClain, & Spruijt-Metz, 2010).

Apart from variability across stress factors, there is apparently also variability across individuals as they show different emotional eating behaviours (Macht, 2008). The relationship that was found between stress and enhanced emotional eating is generally accepted, as emotional eating is defined as overeating in reaction to emotional arousal. People with an emotional eating attitude have learnt to label the negative feelings of stress as 'hunger' (Bruch, 1964). Furthermore, eating may be used as a way to cope with stress and it may also induce stress reduction and increase reward feelings (Adam & Epel, 2007; Dallman et al., 2003).

Emotional eating behaviour and dietary patterns

No significant associations were seen between emotional eating behaviour and dietary patterns. Nevertheless, some preliminary although contradicting evidence exists in literature. For preadolescent children, no studies with similar analyses were found, although two studies should be mentioned. First, in a study using another emotional eating behaviour questionnaire (i.e. the Emotion-Induced Eating Scale), emotional eating has been associated with more sweet foods, but not with fatty foods (Striegel-Moore et al., 1999). Second, using the parental-report DEBQ, emotional

Table 3
Regression analyses: effect of emotional eating behaviour and stress factors on dietary patterns (food indices as dependent variables).

	Snacks			Sweet foods			Fatty foods			Fruit and vegetables		
	Beta	*t*	*p*	Beta	*t*	*p*	Beta	*t*	*p*	Beta	*t*	*p*
Emotional eating	0.011	0.217	0.828	−0.011	−0.216	0.829	0.035	0.712	0.477	−0.050	−1.018	0.310
Factor 1: Problems	0.004	0.082	0.934	0.150	3.039	0.003*	0.115	2.308	0.022*	−0.045	−0.896	0.371
Factor 2: Negative emotions	−0.026	−0.523	0.601	0.026	0.529	0.597	0.061	1.219	0.224	−0.026	−0.509	0.611
Factor 3: Events	−0.048	−0.956	0.340	−0.011	−0.211	0.833	−0.086	−1.730	0.084	−0.106	−2.127	0.034*

* $p < 0.05$; confounding variables (age, sex, socioeconomic status and fat percentage) have been taken into account in the statistical analysis.

Table 4
Regression analyses: effect of stress factors on emotional eating behaviour (emotional eating as dependent variable).

	Emotional eating		
	Beta	*t*	*p*
Factor 1: Problems	0.114	2.249	0.025*
Factor 2: Negative emotions	0.116	2.309	0.021*
Factor 3: Events	0.204	4.146	<0.001*

* $p < 0.05$; confounding variables (age, sex, socioeconomic status and fat percentage) have been taken into account in the statistical analysis.

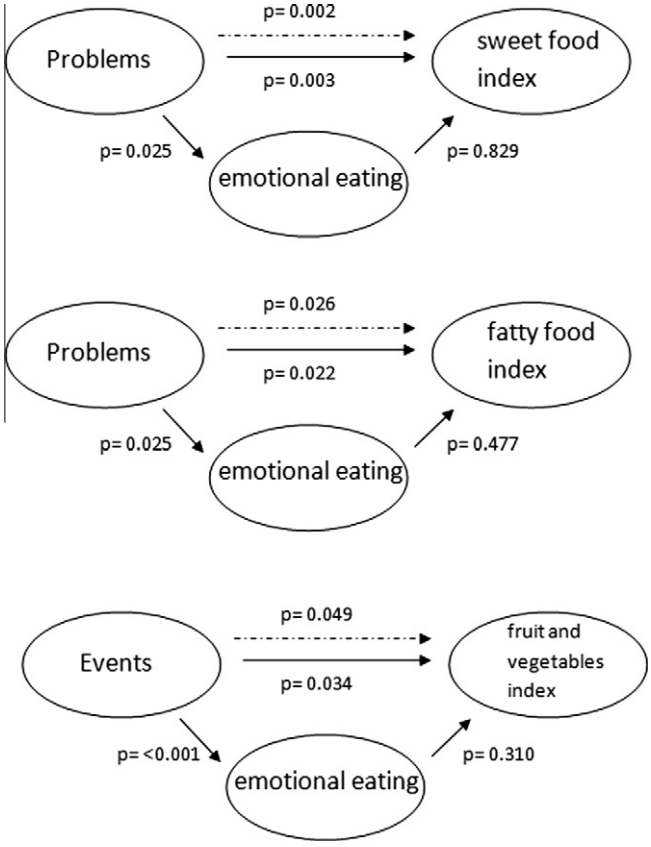


Fig. 1. Mediation models (for which at least two out of four conditions were met): eating behaviour (emotional eating) as mediator in the stress–dietary patterns relation. The solid lines show the regression of the direct effect. The dashed lines show the regression corrected for emotional eating.

eating in children was related with a more fatty and sweet food consumption frequency (Braet & Van Strien, 1997). In adolescents, some researchers also found more sweet food consumption in emotional eaters (Nguyen-Michel, Unger, & Spruijt-Metz, 2007), while others not (Wardle et al., 1992) or only in girls (Elfhag, Tholin, & Rasmussen, 2008). In a laboratory study, snacking was high in emotional/external eaters (Moens & Braet, 2007). Indeed, emotional eating has been convincingly hypothesized to increase the intake of comfort foods (Macht, 2008).

Several factors may explain the unexpected absence of an emotional eating behaviour–dietary patterns relationship. First, the diet of primary school children is still highly influenced and controlled by parents. Therefore, stressed children may have a higher desire to eat, but do eventually not get access to the food via their parents or at least not that their parents know. Indeed, studies have shown that children's diet and emotional eating behaviour is correlated with that of their parents (Brown & Ogden, 2004; Longbottom, Wrieden, & Pine, 2002; van Strien & Bazelier, 2007). Nevertheless, a recent meta-analysis/review has shown that the parent–child relation should not be overstated and that there is a trend of diminishing influence the last decade by changing society (i.e. increasing importance of other influencing players like school and peers) (Wang, Beydoun, Li, Liu, & Moreno, 2011). Moreover, the intake of sweet foods in 12-year olds was influenced by their emotional eating behaviour above the parental influence. In this context, age could be an important factor as in 7–9 years old children the perceived parental eating restriction could prevent the child's emotional eating more than in the older group (van Strien & Bazelier, 2007). The parental influence thus seems to be higher in young children.

Furthermore, emotional eating behaviour and dietary patterns have been reported by different reporters, respectively children and parents. Associations were highest when data from the same reporter was used: parental report of their child's problems and dietary patterns, children's report of their events and emotional eating behaviour.

Moreover, some limitations on questionnaires should be considered. The FFQ is not quantitative as portions were not assessed. As stress might sometimes change total food intake (Macht, 2008), the real influence on the dietary patterns could be obscured by total intake. On the other hand, the DEBQ has also many questions on the intention to eat (e.g. do you have more appetite in that situation) instead of the factual act of eating (=giving in to the desire). As non-overweight children might more closely control their desire (Moens & Braet, 2007), the relationship between emotional eating behaviour and the actual diet could be absent in our low-overweight group. Using another questionnaire with focus on the act of eating instead of only the desire (the Emotion-Induced Eating Scale), emotional eating was indeed related with more sweet food intake (Striegel-Moore et al., 1999). Finally, different clusters of emotional eating behaviour have previously been shown (e.g. dieters with emotional eating and those without) (Lindeman & Stark, 2001). As different eating behaviours may result in different dietary patterns, clustering of eating behaviours could be a complicating factor.

Sex differences

We noted sex differences in 'stress' experiences. Although no gender differences were found for dietary patterns and emotional

eating behaviour, sex differences were present in the relation of stress versus dietary patterns and emotional eating behaviour. More specifically, the three "stress–dietary patterns" relations and the "stress factor Problems–emotional eating" association were only significant for girls while the association between the stress factor Emotions–emotional eating was only significant for boys.

Indeed, sex differences have been shown in children's psychological functioning and development (Crick & Zahn-Waxler, 2003). Also, different comfort food preferences may exist across sex: women tend to prefer snack-related comfort foods while men preferred more nutritious meal-related foods (Wansink, Cheney, & Chan, 2003). Research on those sex differences is still ongoing. Consistent with our results, stress and depression have been related to dietary patterns in female students but not in male students (Mikolajczyk, El Ansari, & Maxwell, 2009).

Mediation

Only two out of four mediation conditions were met as the relation emotional eating behaviour–dietary patterns was absent. Therefore, emotional eating was no mediator in the stress–dietary patterns relationship. Research considering stress, emotional eating behaviour and dietary patterns together is scarce. To our knowledge, emotional eating behaviour has only been investigated as mediator in one study in 3714 adults. These authors have shown emotional eating as mediator in the relation between depression and consumption frequency of sweet energy-dense food, but not in non-sweet energy-dense food and fruit/vegetables (Konttinen, Mannisto, Sarlio-Lahteenkorva, Silventoinen, & Haukkala, 2010). In children, one relevant study examining our hypothesis was found, though a question on eating as a coping mechanism instead of an emotional eating behaviour questionnaire was used. In those children between 8 and 13 years old, mutual correlations between stress, unhealthy food and eating as coping were detected, but mediation was not examined (Jenkins et al., 2005). Another study in 9–12 year old children found relations of emotional eating behaviour with both diet and stress, but reported no information on stress versus diet (Braet & Van Strien, 1997).

Strengths and limitations

As far as we know, this is the first study examining the mediation effect of children's emotional eating behaviour in the relation stress–dietary patterns. At this moment, only one study has already demonstrated this in adults (Konttinen et al., 2010). Major strengths are the direct measurement of dietary patterns, the multi-informant approach and the use of several aspects of dietary pattern and stress.

Still, some limitations have to be mentioned. Because of the quite large questionnaire battery, the responder burden was already high and no information on parental control and parental dietary habits was obtained. Secondly, the study population had a rather high socioeconomic status, leading to an overall healthy diet and low overweight percentage. Consequently, our results cannot be generalized to the overall population. Thirdly, dietary information was obtained by a FFQ, giving no qualitative information on total dietary intake. Nevertheless, using a FFQ has the advantage of showing the habitual diet as dietary recalls can be biased by exceptional days. Furthermore, as stated in the discussion, the DEBQ is not only focussing on the factual act of eating in the absence of hunger, but especially on intentions to eat in those situations. Finally, as the analyses were based on cross-sectional data, the mediation model is not a sound argument for causality. The "stress–dietary patterns" association could be bidirectional: diet and some nutrients in particular can also influence mood and stress reactivity (Gibson, 2006).

Conclusions

Stress was associated with emotional eating and an unhealthy dietary pattern and could thus be a trigger to overweight, also in children. We have shown that differences may exist between different constructs of stress (problems, emotions and events). Events were mainly associated with emotional eating. Problems were mainly associated with more frequent intake of fatty foods and especially sweet foods. On the whole, these results highlight the importance of stress reduction (e.g. by age-appropriate sleeping times and enough exercise) and the related unhealthy behaviour. On the individual level, parents and children should be made aware that stress can influence emotional eating behaviour so they can pay attention or anticipate to this behaviour. Children should be trained on their stress coping skills such as problem solving thinking or asking help instead of seeking solace in food. Nevertheless, as no association was found between emotional eating and dietary patterns, emotional eating behaviour was no mediator in the stress – dietary patterns association in children. Further studies should examine the underlying pathways in more detail.

References

Adam, T. C., & Epel, E. S. (2007). Stress, eating and the reward system. *Physiology and Behavior, 91*(4), 449–458.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research. Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173–1182.

Braet, C., Claus, L., Goossens, L., Moens, E., Van Vlierberghe, L., & Soetens, B. (2008). Differences in eating style between overweight and normal-weight youngsters. *Journal of Health Psychology, 13*(6), 733–743.

Braet, C., Soetens, B., Moens, E., Mels, S., Goossens, L., & Van Vlierberghe, L. (2007). Are two informants better than one? Parent–child agreement on the eating styles of children who are overweight. *European Eating Disorder Review, 15*(6), 410–417.

Braet, C., & Van Strien, T. (1997). Assessment of emotional, externally induced and restrained eating behaviour in nine to twelve-year-old obese and non-obese children. *Behaviour Research and Therapy, 35*(9), 863–873.

Brown, R., & Ogden, J. (2004). Children's eating attitudes and behaviour. A study of the modelling and control theories of parental influence. *Health Education Research, 19*(3), 261–271.

Bruch, H. (1964). Psychological aspects of overeating and obesity. *Psychosomatics, 5*, 269–274.

Cartwright, M., Wardle, J., Steggles, N., Simon, A. E., Croker, H., & Jarvis, M. J. (2003). Stress and dietary practices in adolescents. *Health Psychology, 22*(4), 362–369.

Coddington, R. D. (1972). The significance of life events as etiologic factors in the diseases of children. II. A study of a normal population. *Journal of Psychosomatic Research, 16*(3), 205–213.

Crick, N. R., & Zahn-Waxler, C. (2003). The development of psychopathology in females and males. Current progress and future challenges. *Development and Psychopathology, 15*(3), 719–742.

Dallman, M. F., Pecoraro, N., Akana, S. F., La Fleur, S. E., Gomez, F., Houshyar, H., et al. (2003). Chronic stress and obesity. A new view of "comfort food". *Proceedings of the National Academy of Sciences of the United States of America, 100*(20), 11696–11701.

De Vriendt, T., Clays, E., Huybrechts, I., De Bourdeaudhuij, I., Moreno, L. A., Patterson, E., et al. (2011). European adolescents' level of perceived stress is inversely related to their diet quality the Healthy Lifestyle in Europe by Nutrition in Adolescence study. *British Journal of Nutrition*, 1–10.

Dupondt, L. (1992). *Ik voel me zo…. ervaringsgericht werken met verhalen en prentenboeken rond gevoelens bij jonge kinderen*. Leuven: Centrum voor ervaringsgericht onderwijs vzw.

Elfhag, K., Tholin, S., & Rasmussen, F. (2008). Consumption of fruit, vegetables, sweets and soft drinks are associated with psychological dimensions of eating behaviour in parents and their 12-year-old children. *Public Health Nutrition, 11*(9), 914–923.

Flavell, J. H. (1999). Cognitive development. Children's knowledge about the mind. *Annual Review of Psychology, 50*, 21–45.

Folkman, S., & Lazarus, R. S. (1986). Stress-processes and depressive symptomatology. *Journal of Abnormal Psychology, 95*(2), 107–113.

Gibson, E. L. (2006). Emotional influences on food choice. Sensory, physiological and psychological pathways. *Physiology and Behavior, 89*(1), 53–61.

Goodman, R. (1997). The Strengths and Difficulties Questionnaire. A research note. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 38*(5), 581–586.

Goossens, L., Braet, C., Van Vlierberghe, L., & Mels, S. (2009). Loss of control over eating in overweight youngsters. The role of anxiety, depression and emotional eating. *European Eating Disorder Review, 17*(1), 68–78.

Jenkins, S. K., Rew, L., & Sternglanz, R. W. (2005). Eating behaviors among school-age children associated with perceptions of stress. *Issues in Comprehensive Pediatric Nursing, 28*(3), 175–191.

Kanner, A. D., Coyne, J. C., Schaefer, C., & Lazarus, R. S. (1981). Comparison of two modes of stress measurement. Daily hassles and uplifts versus major life events. *Journal of Behavioral Medicine, 4*(1), 1–39.

Konttinen, H., Mannisto, S., Sarlio-Lahteenkorva, S., Silventoinen, K., & Haukkala, A. (2010). Emotional eating, depressive symptoms and self-reported food consumption. A population-based study. *Appetite, 54*(3), 473–479.

Lanfer, A., Hebestreit, A., Ahrens, W., Krogh, V., Sieri, S., Lissner, L., et al. (2011). Reproducibility of food consumption frequencies derived from the Children's Eating Habits Questionnaire used in the IDEFICS study. *International Journal of Obesity, 35*(Suppl. 1), S61–S68.

Lindeman, M., & Stark, K. (2001). Emotional eating and eating disorder psychopathology. *Eating Disorders, 9*(3), 251–259.

Longbottom, P. J., Wrieden, W. L., & Pine, C. M. (2002). Is there a relationship between the food intakes of Scottish 5(1/2)–8(1/2)-year-olds and those of their mothers? *Journal of Human Nutrition and Dietetics, 15*(4), 271–279.

Macht, M. (2008). How emotions affect eating. A five-way model. *Appetite, 50*(1), 1–11.

Madge, N., Hewitt, A., Hawton, K., de Wilde, E. J., Corcoran, P., Fekete, S., et al. (2008). Deliberate self-harm within an international community sample of young people. Comparative findings from the Child & Adolescent Self-harm in Europe (CASE) Study. *The Journal of Child Psychology and Psychiatry, 49*(6), 667–677.

McCance, K. L., Forshee, B., & Shelby, J. (2006). Stress and disease. In K. L. McCance & S. E. Huether (Eds.). *Pathophysiology. The biological basis for disease in adults and children* (Vol. 5). St. Louis: Mosby.

McCrory, M. A., Gomez, T. D., Bernauer, E. M., & Mole, P. A. (1995). Evaluation of a new air displacement plethysmograph for measuring human body composition. *Medicine and Science in Sports and Exercise, 27*(12), 1686–1691.

Michels, N., Vanaelst, B., Vyncke, K., Sioen, I., Huybrechts, I., De Vriendt, T., et al. (2012). Children's Body composition and Stress. The ChiBS study. Aims, design, methods, population and participation characteristics. *Archives of Public Health, 70*, 71.

Mikkila, V., Rasanen, L., Raitakari, O. T., Pietinen, P., & Viikari, J. (2005). Consistent dietary patterns identified from childhood to adulthood. The cardiovascular risk in Young Finns Study. *British Journal of Nutrition, 93*(6), 923–931.

Mikolajczyk, R. T., El Ansari, W., & Maxwell, A. E. (2009). Food consumption frequency and perceived stress and depressive symptoms among students in three European countries. *Nutrition Journal, 8*, 31.

Moens, E., & Braet, C. (2007). Predictors of disinhibited eating in children with and without overweight. *Behaviour Research and Therapy, 45*(6), 1357–1368.

Nguyen-Michel, S. T., Unger, J. B., & Spruijt-Metz, D. (2007). Dietary correlates of emotional eating in adolescence. *Appetite, 49*(2), 494–499.

Nguyen-Rodriguez, S. T., McClain, A. D., & Spruijt-Metz, D. (2010). Anxiety mediates the relationship between sleep onset latency and emotional eating in minority children. *Eating Behaviors, 11*(4), 297–300.

Portzky, G., De Wilde, E. J., & van Heeringen, K. (2008). Deliberate self-harm in young people. Differences in prevalence and risk factors between the Netherlands and Belgium. *European Child and Adolescent Psychiatry, 17*(3), 179–186.

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers: A Journal of the Psychonomic Society, 36*(4), 717–731.

Roemmich, J. N., Wright, S. M., & Epstein, L. H. (2002). Dietary restraint and stress-induced snacking in youth. *Obesity Research, 10*(11), 1120–1126.

Simon, A. E., Wardle, J., Jarvis, M. J., Steggles, N., & Cartwright, M. (2003). Examining the relationship between pubertal stage, adolescent health behaviours and stress. *Psychological Medicine, 33*(8), 1369–1379.

Singer, M. R., Moore, L. L., Garrahie, E. J., & Ellison, R. C. (1995). The tracking of nutrient intake in young children. The Framingham Children's Study. *American Journal of Public Health, 85*(12), 1673–1677.

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhart (Ed.), *Sociological methodology* (pp. 290–312). San Fransisco: Jossey-Bass.

Striegel-Moore, R. H., Morrison, J. A., Schreiber, G., Schumann, B. C., Crawford, P. B., & Obarzanek, E. (1999). Emotion-induced eating and sucrose intake in children. The NHLBI Growth and Health Study. *International Journal of Eating Disorders, 25*(4), 389–398.

UNESCO (2010). *International standard classification of education.* <www.uis.unesco.org>.

van Strien, T., & Bazelier, F. G. (2007). Perceived parental control of food intake is related to external, restrained and emotional eating in 7–12-year-old boys and girls. *Appetite, 49*(3), 618–625.

van Strien, T., Frijters, J. E. R., Bergers, G. P. A., & Defares, P. B. (1986). The Dutch Eating Behavior Questionnaire (Debq) for assessment of restrained, emotional, and external eating behavior. *International Journal of Eating Disorders, 5*(2), 295–315.

Wang, Y., Bentley, M. E., Zhai, F., & Popkin, B. M. (2002). Tracking of dietary intake patterns of Chinese from childhood to adolescence over a six-year follow-up period. *Journal of Nutrition, 132*(3), 430–438.

Wang, Y., Beydoun, M. A., Li, J., Liu, Y., & Moreno, L. A. (2011). Do children and their parents eat a similar diet? Resemblance in child and parental dietary intake. Systematic review and meta-analysis. *Journal of Epidemiology and Community Health, 65*(2), 177–189.

Wansink, B., Cheney, M. M., & Chan, N. (2003). Exploring comfort food preferences across age and gender. *Physiology and Behavior, 79*(4–5), 739–747.

Wardle, J., Marsland, L., Sheikh, Y., Quinn, M., Fedoroff, I., & Ogden, J. (1992). Eating style and eating behaviour in adolescents. *Appetite, 18*(3), 167–183.

Wells, J. C., Williams, J. E., Chomtho, S., Darch, T., Grijalva-Eternod, C., Kennedy, K., et al. (2010). Pediatric reference data for lean tissue properties. Density and hydration from age 5 to 20 y. *The American Journal of Clinical Nutrition, 91*(3), 610–618.

World Health Organization (2003). *Diet, nutrition and the prevention of chronic diseases. Joint WHO/FAO Expert Consultation. WHO technical Report Series no. 916.* Geneva: WHO.

Zimmer-Gembeck, M. J., Lees, D. C., Bradley, G. L., & Skinner, E. A. (2009). Use of an analogue method to examine children's appraisals of threat and emotion in response to stressful events. *Motivation and Emotion, 33*(2), 136–149.