



Reward sensitivity and body weight: the intervening role of food responsive behavior and external eating



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ABSTRACT

Background: During the last three decades, the prevalence of childhood overweight and obesity has increased worldwide. It is well established that different child-related factors such as food approach behaviors (i.e. eating behaviors that imply movements towards food) contribute to the development of overweight. However, research is lacking on the underlying mechanisms leading to food approach behaviors, which in turn lead to overweight.

Subject/Methods: Via parent-report questionnaires, we investigated the relation between the personality trait reward sensitivity and body weight in a convenience sample of 211 children aged 2.5–9 years. We further investigated the intervening role of food approach behaviors in the association between reward sensitivity and body weight.

Results: Unexpectedly, there was no direct association between reward sensitivity and body weight. Despite the absence of a direct effect, a significant indirect association was found between reward sensitivity and body weight through the intervening food approach variables (i.e. food responsive behavior and external eating).

Conclusions: These results highlight the importance of the focus on eating behaviors as well as trait characteristics in prevention programs for overweight.

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1. Introduction

During the last three decades, the prevalence of childhood overweight and obesity has increased worldwide (Hedley et al., 2004; Ng et al., 2014). Despite various prevention efforts, weight problems remain a prevalent health issue; the United States holds childhood overweight and obesity numbers of 22.8% of 2–5-year-olds and 34.2% of 6–11 year-olds, while in Europe, 19.9% of 2–10-year-olds are overweight or obese (Ahrens et al., 2014; Ogden, Carroll, Kit, & Flegal, 2014). Understanding the etiology of weight problems in young children is critical, since childhood overweight tends to persist in adolescence and adulthood, and is likely to progress to obesity (Schokker, Visscher, Nooyens, Van Baak, & Seidell, 2007; Whitaker, Wright, Pepe, Seidel, & Dietz, 1997), which increases the risk of a wide range of medical (e.g. Type 2 diabetics, orthopedic problems) and psychosocial complications

(e.g. low self-esteem, poor body image), both concurrently and in the long term (Daniels, 2009; Lee, 2009; Strauss, 2000).

Parallel to the rise in overweight and obesity prevalence, the current food environment has evolved into an obesogenic environment in which energy-dense, palatable, and thus strongly rewarding foods are highly advertised, readily available, and served in larger portions (Young & Nestle, 2002). These environmental changes facilitate an augmented energy intake and contribute to overweight or obesity (Rolls, 2011). However, not all individuals are susceptible to these environmental influences as not all individuals living in this obesogenic environment gain weight. This observation suggests that, in addition to environmental factors, individual characteristics and related eating behaviors might also be involved in weight control, an assumption that fits well with biopsychosocial models (Davison & Birch, 2001).

One such individual characteristic that has been proposed as a determinant of body weight is reward sensitivity (Davis & Fox, 2008; Franken & Muris, 2005; Verbeken, Braet, Lammertyn, Goossens, & Moens, 2012). A positive relationship between reward sensitivity and Body Mass Index has been found in normal and overweight adults (Franken & Muris, 2005) and children aged

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5–12 years (De Decker et al., 2016; Verbeken et al., 2012). Individuals high in reward sensitivity are considered profoundly sensitive to the rewarding aspects of appetitive stimuli, for example palatable foods. This individual characteristic is assumed to reflect the sensitivity of a neuropsychological system, the Behavioral Approach System (BAS). The BAS reacts to positive, rewarding environmental stimuli by activation of the dopaminergic system (Gray, 1994), which initiates approach behavior in order to obtain the rewarding goal (Kane, Loxton, Staiger, & Dawe, 2004). Following the neuropsychological conceptualization of reward sensitivity, it is assumed that individuals high in reward sensitivity would exhibit more approach behavior to consume rewarding food items, which in turn, would contribute to weight gain (Davis et al., 2007).

Consistent with the first part of this assumption, namely that reward sensitivity may lead to food approach behaviors, it appears that reward sensitivity is implicated in different types of food approach behavior (i.e. eating behaviors that imply a movement towards food). Cross-sectional empirical evidence in adults, as assessed by self-report questionnaires, has indeed shown that reward sensitivity is positively related to binge eating (i.e. the consumption of an unusually large amount of food, accompanied by a sense of loss of control over eating), emotionally driven eating (i.e. eating in response to emotional states) and external eating (i.e. eating in response to food-related stimuli, regardless of hunger or satiety) (Davis et al., 2007; Davis, Strachan, & Berkson, 2004). In children and adolescents, a positive cross-sectional association has been demonstrated between reward sensitivity and the consumption of palatable foods (De Cock et al., 2016; De Cock et al., 2015; De Decker et al., 2016). Even in preschool children, reward sensitivity has been cross-sectionally related to food approach, as assessed by parent-report questionnaires. More specifically, higher reward sensitivity was associated with a stronger enjoyment of food (i.e. the extent to which the child likes and enjoys eating), higher food responsiveness (i.e. the extent to which the child wants to eat, regardless of hunger or satiety) and more external eating (Vandeweghe, Vervoort, Verbeken, Moens, & Braet, 2016).

In line with the second part of the assumption, namely that food approach behavior may lead to weight status, food approach behaviors are found to be implicated in weight gain (for review see French, Epstein, Jeffery, Blundell, & Wardle, 2012). For example, there was a significantly positive relation between children's disinhibited eating (i.e. eating behaviors involving a lack of control over food consumption), assessed by interview and self-report questionnaire, and their adiposity (Hill et al., 2008; Zocca et al., 2011). Furthermore, an increased Body Mass Index in young children correlated with a higher degree of food responsiveness, enjoyment of food and emotional overeating (i.e. the extent to which the child eats more when feeling negative emotions), as assessed by parent-report questionnaires (Carnell & Wardle, 2008; Sleddens, Kremers, & Thijs, 2008; Viana, Sinde, & Saxton, 2008; Webber, Hill, Saxton, Van Jaarsveld, & Wardle, 2009). Similarly, in a clinical study, children with obesity tend to display more external eating, as assessed by a parent-report questionnaire, compared to non-obese children (Braet & Van Strien, 1997).

Despite the relevance of reward sensitivity and food approach behaviors as determinants of weight gain, only few studies in this age group (i.e. children aged 2.5–9 years) have investigated its underlying mechanisms, such as the assumption that food approach behavior might constitute the pathway through which reward sensitivity influences body weight. It is important to find evidence for underlying mechanisms such as these, which can help to guide prevention programs. So far, only one cross-sectional study with adult women showed that reward sensitivity predicted overeating, which in turn predicted body mass (Davis et al., 2007). A

second cross-sectional study with elementary school children found that overeating indeed mediated the relationship between reward sensitivity and body mass (Van den Berg et al., 2011). To our knowledge, the small number of studies investigating this relationship did not include preschool children. Moreover, a direct relation between reward sensitivity and body weight has not yet been evidenced in preschool children.

The first aim of the current study is to examine the relation between reward sensitivity and body weight in a convenience sample of young children aged 2.5–9 years. We expect that reward sensitivity correlates significantly positively with body weight. The second aim is to investigate the intervening role of two operationalisations of food approach behavior (i.e. food responsive behavior and external eating) in the association between reward sensitivity and body weight. We expect that high reward sensitivity is related to an enhanced display of food approach behavior, which in turn is associated with increased body weight.

2. Method

2.1. Participants

The participant sample consisted of 211 mothers of young children (55.5% boys; age: $M = 6.27$; $SD = 1.60$; range: 2.43–9.22). Of these participants, data provided by 98 mothers of preschool children (56.1% boys; age: $M = 4.87$; $SD = 1.13$) have been used in a different paper in which reward sensitivity proved to be related to several types of food approach (Vandeweghe, Vervoort, et al., 2016). According to the Highest Household Educational Attainment (HHEA, as a proxy for Socio Economic Status), 87.6% of the households have a bachelor's degree or higher and 12.4% have completed high school. Data on HHEA were missing in 0.5% of the cases.

2.2. Procedure

This study was conducted as part of the Reward project. In October 2013, 98 mothers of preschool children were recruited by third-year psychology students of Ghent University for a partial fulfillment of course requirements. Each student had to find two families with a preschool child (via relatives, friends, acquaintances, school,...) that were willing to participate. The students were thoroughly informed about the content of the questionnaires and trained to administer them. They were instructed to visit the participants at home, administer the questionnaire in a quiet place, and be available when questions arose. Prior to completing the questionnaires, active informed consent was obtained from each mother. In April 2015, 113 mothers of 1st and 2nd year elementary-school children were recruited in cooperation with a fourth-year psychology student via elementary schools in the neighborhood of Ghent, Belgium. The recruitment letter referred to a website where mothers could complete the questionnaires online. Both the recruitment letter and the homepage of the website included informed consent information. The study procedure was conducted in accordance with the ethical guidelines of the institutional Ethical Committee.

2.3. Materials

2.3.1. Adjusted Body Mass Index (*adjBMI*)

The mothers were asked to report weight (in kg) and height (in cm) of their child. The study uses adjusted BMI instead of BMI because it is more appropriate and reliable for children, as this formula takes age and sex into account. First, BMI was calculated by dividing weight (in kg) through squared height (in m^2). Then, *adjBMI* was calculated by (BMI/the 50th percentile of BMI for age

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