



The association between overweight and internalizing and externalizing behavior in early childhood



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ABSTRACT

Objective: The aim of this study was to examine bidirectional associations between overweight and behavior problems during early childhood taking into account the adiposity rebound, which is the turning point in the nonlinear development of Body Mass Index in early childhood.

Methods: Longitudinal data from 6624 Dutch children in the Generation R Study were used to analyze the association between measured overweight and scores on the internalizing and externalizing scale of the Child Behavior Checklist between one-and-a-half, three and six years. The adiposity rebound was determined for each child by estimating the lowest point in their growth curve. Cross-lagged modeling was used to test (bi)directional associations.

Results: Both body mass and behavior problems were modest to highly stable from age one-and-a-half to six years. Externalizing and internalizing behavior were both associated with later overweight, although effect sizes were small (β s ranged between 0.06 and 0.07, $ps < 0.05$). No significant associations in the other direction were found. Controlling for adiposity rebound did not change the pattern of associations. There was a moderating effect of gender, and ethnicity, and timing of adiposity rebound.

Conclusion: Behavior problems in early childhood may put children at risk for overweight at a later age. This implies that young children with behavior problems may benefit from careful monitoring of eating behavior and weight development. Future studies should take the adiposity rebound into account.

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The prevalence of childhood overweight and obesity has increased significantly over the last twenty years (De Onis et al., 2010). Children with overweight usually maintain their overweight status into adolescence and adulthood (e.g. Hesketh et al., 2004; Katzmarzyk et al., 1999) and are at risk for negative psychological outcomes (Pulgarón, 2013). Childhood overweight has been found to relate to premature death and increased odds of illness in adulthood, regardless of adult adiposity (e.g., Reilly and Kelly, 2011). Furthermore, it has been argued that primary prevention of adult overweight should take place between the ages of

two to six years, because weight gain in this critical period is the best predictor of adult adiposity (De Kroon et al., 2010). Therefore, it is important to determine which factors relate to the origin of childhood overweight. Possible relevant factors are internalizing and externalizing behavior, which at the age of five years are related to adult overweight, regardless of childhood overweight, nutrition and lifestyle (Mamun et al., 2009). Furthermore, a parenting intervention on behavioral problems in four-year olds had beneficial effects on obesity rates three to five years later (Brotman et al., 2012). The association between behavior problems and overweight can be explained by shared risk factors, but also by adverse parenting practices in which parents react to problem behavior by encouraging unhealthy behavior. In early childhood, this association has been studied (e.g., Bradley et al., 2008; Garthus-

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Niegel et al., 2010; Lawlor et al., 2005), but without taking into account the ‘adiposity rebound’, which is the turning point of Body Mass Index (BMI) that occurs in early childhood. Children’s BMI does not increase linearly over time: It first increases until it reaches a peak in the first 9 months (Johnson et al., 2013), after which it decreases, before starting to increase again between three and seven years of age. This last turning point is called the adiposity rebound (Cole, 2004). An early adiposity rebound is a risk factor for subsequent overweight because it identifies the children with a high BMI centile, which in its turn is related to prospective overweight (Cole, 2004; Rolland-Cachera et al., 2006). It is relevant to take the adiposity rebound into account, because it may affect the interpretation of associations between body mass and behavior. The current study examines the prospective association between body mass and behavior problems in early childhood, while taking into account the adiposity rebound.

There are several mechanisms that may explain associations between behavior and overweight. These mechanisms may be different for internalizing behavior (e.g., social withdrawal, anxiety, depression), than for externalizing behavior (e.g., impulsivity, aggression, and hyperactivity). High BMI and *externalizing* behavior could share a number of risk factors (e.g., low socioeconomic status, diminished self-regulation skills, and difficult temperament), and may therefore simply be related to each other without one *causing* the other. However, externalizing behavior could also lead to overweight through mechanisms such as inadequate parenting behavior, behavior of parents or parental reactions to their children. Parents of children with externalizing behavior may give in to certain demands for sweets and sedentary activities such as gaming or watching television to avoid the child’s difficult behavior, which in turn may lead to childhood overweight (Mamun et al., 2009). This is also in line with previous research by Rodgers et al. (2013), who indicated that instrumental feeding practices, such as using food as positive and negative reinforcement, is related to weight gain of the child.

The literature is scarce and inconsistent concerning whether there is an association between BMI and externalizing behavior in early childhood: Only a limited number of studies have focused on the association between overweight and externalizing behavior in early childhood, and these studies are mostly cross-sectional and show inconsistent results (e.g., Lawlor et al., 2005; Mackenbach et al., 2012). In addition, three studies adopted a symmetric longitudinal design – a design that permits conclusions on bidirectional effects over time – and their findings are contradictory as well (Anderson et al., 2010; Bradley et al., 2008; Garthus-Niegel et al., 2010). Therefore, this association should be investigated further, while taking the adiposity rebound into account.

Similar to the association between overweight and externalizing behavior, shared risk factors (e.g., low socioeconomic status, parental internalizing behavior, and serotonin and cortisol levels) could also explain the association between overweight and *internalizing* behavior. It has also been suggested, however, that overweight could indirectly *lead to* internalizing behavior. Children with overweight may be frustrated, because they have more difficulty in participating in certain physical activities with other children (Trost et al., 2003), or because they are rejected by peers due to their weight status (Puhl and Latner, 2007). In contrast, internalizing behavior could also lead to overweight. Studies in adolescence and adults indicate that individuals with internalizing behavior often show emotional eating, which is a coping mechanism whereby eating is used to deal with emotional problems (Ouwens et al., 2009), which could lead to weight increase. In early childhood, parents may use ‘comfort food’ as well to comfort their child, and reduce stress and anxiety (e.g., Stifter et al., 2011), potentially leading to overweight.

Cross-sectional studies show diverging results concerning the association between BMI and internalizing behavior in early childhood (e.g., Mackenbach et al., 2012; Sawyer et al., 2006). Only three longitudinal studies have investigated the association between BMI and internalizing behavior using symmetrical longitudinal designs, and none of these found significant associations in early childhood (Bradley et al., 2008; Garthus-Niegel et al., 2010; Lawlor et al., 2005).

All in all, although theoretically plausible, there is no consistent evidence to indicate whether or not there is an association between a high BMI and behavioral problems in early childhood. An important reason for this might be that previous studies covered only part of the adiposity rebound period and did not account for the timing of the rebound, which may have led to erroneous conclusions. The timing of the adiposity rebound usually takes place between three and seven years, but its timing is different for each child (Cole, 2004). Depending on where a child is situated on the adiposity rebound curve, BMI could be either decreasing or increasing, which could affect the strength and even the direction of prospective associations with other variables.

The aim of the current study was to investigate the association between the development of body mass and the development of externalizing and internalizing problems during early childhood in a longitudinal study, taking into account for each participant the individual adiposity rebound and their relative position to it. In addition, it was tested whether gender, ethnicity or timing of adiposity rebound moderate these associations. We employed a symmetrical design with three waves of data collection (one-and-a-half, three, and six years). Data were collected within the Generation R study (Jaddoe et al., 2012), a large prospective birth cohort study situated in Rotterdam (The Netherlands).

1. Method

1.1. Study design

This study was embedded within the Generation R study, a multi-ethnic population-based prospective cohort study from early fetal life onwards in Rotterdam, The Netherlands, that investigates growth, development, and health (Jaddoe et al., 2012). The study has been approved by the Medical Ethical Committee of the Erasmus Medical Center in Rotterdam. Written consent was obtained from all parents of participating children. All participating children were born between 2002 and 2006. In the Generation R study there is a prenatal phase and two postnatal phases (zero–four years, and five–six years). The current study utilizes data from three waves that took place within those two postnatal phases. The first wave was conducted at age one-and-a-half years, the second wave at three years, and the third wave at six years.

1.2. Participants

In total, 6624 children participated in both postnatal phases (zero–four years, and five–six years) and had data on at least one of the three waves included in the current study. Of this sample, 50.2% of the children were boys, 66% had a Western (primarily Dutch) ethnicity and 34% had a Non-Western ethnicity (Turkish, Surinamese, Moroccan, Antillean, and other). In addition, 16.5% of the sample had a low monthly net income (less than €2000), 43% had a middle net income (between €2000 and €4000) and 40.5% had a net income more than €4000. Sixty-six percent of mothers had a higher education, 32% finished secondary education and 2% finished only primary school. The average age of the children in each wave was 18.45 months ($SD = 1.13$) for wave 1, 36.67 months ($SD = 1.46$) for wave 2, and 71.81 months ($SD = 4.60$) for wave three.

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