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Observed self-regulation is associated with weight in low-income toddlers

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ABSTRACT

Obesity emerges in early childhood and tracks across development. Self-regulation develops rapidly during the toddler years, yet few studies have examined toddlers' self-regulation in relation to concurrent child weight. Further, few studies compare child responses in food and non-food-related tasks. Our goal was to examine toddlers' observed behavioral and emotional self-regulation in food and non-food tasks in relation to their body mass index z-score (BMIz) and weight status (overweight/obese vs. not). Observational measures were used to assess self-regulation (SR) in four standardized tasks in 133 low-income children (M age = 33.1 months; SD = 0.6). Behavioral SR was measured by assessing how well the child could delay gratification for a snack (food-related task) and a gift (non-food-related task). Emotional SR was measured by assessing child intensity of negative affect in two tasks designed to elicit frustration: being shown, then denied a cookie (food-related) or a toy (non-food-related). Task order was counterbalanced. BMIz was measured. Bivariate correlations and regression analyses adjusting for child sex, child race/ethnicity, and maternal education were conducted to examine associations of SR with weight. Results were that better behavioral SR in the snack delay task associated with lower BMIz ($\beta = -0.27$, $p < 0.05$) and lower odds of overweight/obesity (OR = 0.66, 95% CI 0.45, 0.96), but behavioral SR in the gift task did not associate with BMIz or weight status. Better emotional SR in the non-food task associated with lower BMIz ($\beta = -0.27$, $p < 0.05$), and better emotional SR in food and non-food tasks associated with lower odds of overweight/obesity (OR = 0.65, 95% CI 0.45, 0.96 and OR = 0.56, 95% CI 0.37, 0.87, respectively). Results are discussed regarding how behavioral SR for food and overall emotional SR relate to weight during toddlerhood, and regarding early childhood obesity prevention implications.

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1. Introduction

Self-regulation (SR) can be defined as the capacity to control one's behaviors and emotions when challenged in order to pursue a goal. SR is proposed to underlie many health-related behaviors in adults, particularly eating and weight management (Vohs & Heatherton, 2000). Nearly one in five US children are obese, with a body mass index (BMI) at or above the 95th percentile for age and sex, by age four years (Anderson & Whitaker, 2009). Given that obesity, once established, is highly likely to track throughout childhood and into adulthood (Freedman et al., 2005; Nader et al., 2006) there is a critical need to understand the mechanisms via which obesity develops prior to age 5 years. Children dramatically increase their behavioral and emotional SR skills across the toddler period (approximately 18 months to 3 years) as they learn how to control their impulsive behaviors and emotional responses when placed in situations that challenge these SR capacities (Calkins, Brownell, & Kopp, 2007; Jennings, 2004; Kochanska, Murray, & Harlan, 2000). Furthermore, weight trajectories prior to age 3 years are strong independent predictors of later overweight (Ong & Loos, 2006; Slining, Herring, Popkin, Mayer-Davis, & Adair, 2013).

Abbreviations: BMIz, body mass index z-score; SR, self-regulation; BMI, body mass index.

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Both SR and eating behaviors that may contribute to overweight are shaped early in life by biological as well as behavioral and social-relational processes such as modeling by parents and caregivers (Blissett, Haycraft, & Farrow, 2010; Calkins et al., 2007). As early childhood SR can be enhanced through classroom-based (Blair & Diamond, 2008) and parenting-focused interventions (Chang, Shaw, Dishion, Gardner, & Wilson, 2014), it is important to consider SR during the toddler period as a potential pathway for health promotion, specifically obesity prevention in early childhood (Miller et al., 2012).

1.1. Behavioral SR and weight in children

Impulsivity, or a lack of inhibitory control, is an indicator of poor behavioral SR that has been associated with higher weight status and BMI among school-aged children and adolescents (see Liang, Matheson, Kaye, & Boutelle, 2014; Thamotharan, Lange, Zale, Huffhines, & Fields, 2013 for reviews). Although the association is hypothesized to operate through an impulsive child's inability to delay gratification for tempting food (Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006), many studies of school-aged children assess behavioral SR in non-food tasks (C. Braet, Claus, Verbeken, & Van Vlierberghe, 2007; Cserjesi, Molnar, Luminet, & Lenard, 2007; Delgado-Rico, Rio-Valle, Gonzalez-Jimenez, Campoy, & Verdejo-Garcia, 2012; Duckworth, Tsukayama, & Geier, 2010; Fields, Sabet, & Reynolds, 2013; Nederkoorn, Jansen, Mulkens, & Jansen, 2007; Verbeken, Braet, Claus, Nederkoorn, & Oosterlaan, 2009). Some researchers have suggested that assessing SR failures specifically for food may be more important than general inhibitory control failures for weight outcomes, as children with food-specific SR failures likely eat more obesogenic foods (Nederkoorn, Coelho, Guerrieri, Houben, & Jansen, 2012). Yet, studies typically do not compare behavioral SR in food-related and non-food-related tasks with respect to child weight, and the few studies that have done so in younger children have yielded mixed results (Francis & Susman, 2009; Hughes, Power, O'Connor, & Orlet Fisher, 2015). It is therefore not well-understood whether poor behavioral SR in general or specifically in food-related contexts is most relevant for obesity risk during early childhood.

A number of studies have found that behavioral SR in food tasks, specifically the ability to delay gratification for food during the preschool years (3–5 years of age) predicts later, though not concurrent weight outcomes (see Caleza, Yañez-Vico, Mendoza, & Iglesias-Linares, 2016 for recent review). Poorer behavioral SR for food at preschool-age has been associated with higher BMI in middle childhood (ages 11–12 years) (Francis & Susman, 2009; Seeyave et al., 2009) and in adulthood (Schlam, Wilson, Shoda, Mischel, & Ayduk, 2013). Yet, concurrent associations between behavioral SR for food and child weight during this frequently studied 3- to -5-year age range are inconsistent. Two studies reported no concurrent association between behavioral SR for food and weight at this age (Francis & Susman, 2009; Hughes et al., 2015), although one of these studies found associations between poorer behavioral SR in a non-food task and higher concurrent BMI (Hughes et al., 2015). Another study found that behavioral SR in a snack task at age 3 years was unrelated to concurrent BMI and associated with lower BMI by age 4 years for girls only (Silveira et al., 2012). Finally, in a small study of 3- to 6-year olds ($n = 37$), low executive function skills, which often underlie poor behavioral SR, were associated with obesity-promoting eating behavior but not with BMI (Pieper & Laugero, 2013). This study did not assess behavioral SR in food tasks, however.

Behavioral SR for food has not been studied in relation to weight outcomes in children younger than age 3 years. This is an important oversight because children are just beginning to develop independent SR capacities due to their rapidly increasing cognitive and social skills (Calkins et al., 2007) and capacity for goal-directed behavior (Jennings, 2004) during the toddler period. Thus, although parents continue to play a role, children's self-directed abilities to delay gratification for tempting foods and increased autonomy over food choices may start to drive their eating behaviors and over time, their risk for overweight. Assessing whether poor behavioral SR is associated with early weight outcomes prior to age 3 years is critical because weight trajectories prior to age 3 predict adult weight status (Slining et al., 2013). As childhood obesity rates are high as of the preschool years (Anderson & Whitaker, 2009), interventions have therefore proposed focusing on behavioral SR as a mechanism for obesity prevention during early childhood (Miller et al., 2012). The only prior study to examine behavioral SR and weight in children under 3 years of age used non-food tasks, finding that behavioral inhibition in a gift delay task at age 2 years was associated with lower concurrent child BMI, as well as BMI at age 5 (Graziano, Calkins, & Keane, 2010) and age 13 years (Graziano, Kelleher, Calkins, Keane, & Brien, 2013). Behavioral SR for food was not examined in this study.

Thus, the literature on how behavioral SR in food and non-food tasks relates to concurrent child weight during early childhood is inconsistent and few studies have compared behavioral SR in food and non-food tasks. Furthermore, there is a gap in the science regarding how behavioral SR in food- and non-food tasks relates to weight in children younger than 3 years of age. Understanding children's capacity to control their behavioral impulses in food- and non-food tasks during the toddler period when weight trajectories are becoming established and independent SR skills are rapidly developing is important, as identifying early-emerging contextual specificity in behavioral SR skills may provide insight into later obesity risk.

1.2. Emotional SR and weight in children

Emotional SR, or the capacity to remain calm in challenging or frustrating situations, is another key aspect of SR that develops across toddlerhood, and may be important in decreasing potential stress-eating pathways to obesity (Groesz et al., 2012). Very young children who request to eat when they are frustrated as an emotion regulation strategy may be at risk for excessive weight gain over time if they routinely engage in this behavior; indeed, preschool-aged children whose parents reported frequent temper tantrums over food were heavier (Agras, Hammer, McNicholas, & Kraemer, 2004). Emotional over-eating as measured by the Child Eating Behavior Questionnaire (Wardle, Guthrie, Sanderson, & Rapoport, 2001) has been shown to increase from early to middle childhood (Ashcroft, Semmler, Carnell, van Jaarsveld, & Wardle, 2007) and has been associated with higher weight outcomes in preschool (Domoff, Miller, Kaciroti, & Lumeng, 2015) and obesity among school-aged children (C. Braet & Van Strien, 1997). Studies have also shown consistent associations between early negativity in infants and higher weight outcomes (Carey, 1985; Darlington & Wright, 2006) (see Anzman-Frasca, Stifter, & Birch, 2012 for review). Findings therefore suggest that poor emotional SR early in development may be important, but almost all of these prior studies have relied on parent report.

Using observational methods to assess emotional SR in young children may yield additional information about the child's ability to regulate emotions in the moment and have less potential bias than parent report. Of the two studies we could identify that used observational measures to assess emotional SR and weight in young children, one study found that observed but not parent-reported infant negativity was associated with faster infant weight gain from 1 to 3 years, that the association was stronger when parents

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