Executive functioning in a racially diverse sample of children who are overweight and at risk for eating disorders

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ABSTRACT

Difficulties with executive functioning may underlie both overweight and loss of control (LOC) eating behavior across the age spectrum, but there is a relative paucity of research in children with both conditions. This study aimed to characterize general executive functioning among children with overweight and LOC eating as compared to their overweight and normal-weight peers. Participants were 75 racially diverse children (58.7% female; 81.3% African-American), aged 9-12y (M age = 10.5 ± 1.1), of whom 26 were overweight/obese and endorsed LOC eating (OW-LOC), 34 were overweight controls (OW-CON), and 15 were normal-weight controls (NW-CON). All children completed interview-based measures of eating pathology, and behavioral measures of executive functioning. Parents reported on behavioral facets of children's executive functioning. Groups were compared across parent-report measures and behavioral tasks using analyses of covariance (ANCOVAs) and multivariate analyses of covariance (MANCOVAs) which adjusted for general intellectual functioning. Significant group differences were revealed on a behavioral measure of planning, the Tower of London task [F (2,71) = 5.32; p = 0.007], and a behavioral measure of working memory, the List Sorting task [F (2,71) = 6.45; p = 0.003]. Post-hoc tests revealed that OW-LOC and OW-CON performed worse than NW-CON on the Tower of London, with relative decrements in accuracy rather than performance time. Further, OW-LOC performed worse than both OW-CON and NW-CON on the List Sorting task. Overweight with or without concomitant LOC eating in children may characterize a unique pattern of executive dysfunction. Interventions for eating- and weight-related problems in youth should address underlying deficits in planning and working memory.

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1. Introduction

Pediatric obesity is a major public health concern that is linked to the development of cardiovascular risk factors in childhood (Reilly et al., 2003) and a wide range of health concerns in adulthood (Al Mamun, Cramb, O’Callaghan, Williams, & Najman, 2009; Baker, Olsen, & Sorensen, 2007; Field, Cook, & Gillman, 2005). Loss of control (LOC) eating, characterized by a sense that one cannot control what or how much one is eating, is an obesity-related phenotype that presents in up to 20% of non-treatment seeking youth with overweight or obesity (He, Cai, & Fan, 2016) and is associated with the development of eating disorders and other serious health impairments (Goldschmidt, Loth, et al., 2015).
Executive functioning refers to cognitive activities directed towards achievement of a desired goal and involves a range of processes such as decision-making, planning, attention, problem-solving, inhibition, and cognitive flexibility, among others (Anderson, 2008; Chan, Shum, Toulopoulou, & Chen, 2008). Healthy regulation of eating behavior and body weight involves several aspects of executive functioning (e.g., generating a meal plan, inhibiting goal-incompatible responses to food cues). Poorer performance on behavioral measures of executive functioning has been related to obesity in both children (Liang et al., 2014; Verbeken, Braet, Claus, Nederkoorn, & Goossens, 2014; Burbeck, Braet, Claus, Nederkoorn, & Oosterlaan, 2009) and adults (Fitzpatrick, Gilbert, & Decaluwe, 2007; Schluter, Schmidt, Kittel, Tetzlaff, & Hilbert, 2016). Preliminary research suggests that difficulties with executive functioning may underlie both obesity (Fitzpatrick, Gilbert, & Serpell, 2013; Liang, Mathesone, Kaye, & Bottel, 2014) and LOC eating behavior (Van den Eynde et al., 2011) across the age spectrum, with LOC eating in adults characterized by difficulties with problem-solving, decision-making, and inhibition, above and beyond the effects of obesity (Manasse et al., 2015, 2016, 2014). However, there is a relative paucity of research in children. Characterizing executive functioning in children with comorbid overweight and LOC eating could have important implications for prevention and treatment development, including helping to identify youth who may be at risk for excess weight gain and eating disorders (TanoFSky-Kraff et al., 2006, 2011, 2009), and highlighting relevant early intervention targets.

Executive functioning is a broad construct that includes aspects such as working memory, inhibitory control, cognitive flexibility, among others (Anderson, 2008; Chan, Shum, Toulopoulou, & Chen, 2008). It is defined as the ability to plan, organize, and regulate one’s behavior to accomplish a goal (Duckworth, Tsukayama, & Hilbert, 2010; Reinblatt, Leoutsakos, et al., 2015; Reinblatt, Geier, 2010; Francis & Curtis, 2016; Susman, 2009; Curtiss, 2016; Groppe & Keenan, 2015; Groppe & Elsner, 2015; Keike, Hardy, & Richards, 2016). Executive functioning activities are involved in a wide range of behaviors, including managing food intake in order to maintain healthy weight, managing the intake of non-food items, and managing emotion in order to avoid negative outcomes. Executive functioning deficits may be associated with various problems, including obesity and LOC eating.

Executive functioning deficits have been associated with obesity and LOC eating in children. Liang et al. (2014) found that executive functioning deficits were associated with obesity in children. Verbeken et al. (2014) found that executive functioning deficits were associated with LOC eating in children. However, there is a relative paucity of research in children. Characterizing executive functioning in children with comorbid overweight and LOC eating could have important implications for prevention and treatment development, including helping to identify youth who may be at risk for excess weight gain and eating disorders (TanoFSky-Kraff et al., 2006, 2011, 2009), and highlighting relevant early intervention targets.

2. Material and methods

2.1. Participants

Participants were 75 children (58.7% female; n = 44), aged 9-12y (M age = 10.6 ± 1.1), who self-identified as African-American (81.3%; n = 61), non-Hispanic Caucasian (12.0%; n = 9), non-Caucasian Hispanic (5.3%; n = 4), or Asian (1.3%; n = 1), which reflects the demographics of the study site. The sample was comprised of 26 youth with overweight/obesity (body mass index [BMI; kg/m²] ≥ 85th percentile for age and sex according to Centers for Disease Control and Prevention (CDC) normative data; Kuczmarski et al., 2000) who reported recent LOC eating (i.e., ≥1 episode of LOC eating in the 3 months prior to assessment; OW-LOC), 34 controls with overweight who reported no history of LOC eating (OW-CON), and 15 (BMI < 85th percentile for age and sex) controls who were normal-weight and denied any history of LOC eating (NW-CON). Within the OW-LOC sample, 5 participants (19.2%) reported objectively large LOC episodes only, 17 (65.4%) reported subjectively large LOC episodes only, and 4 (15.4%) reported both objectively and subjectively large LOC episodes. The sample size was selected to provide 80% power to detect a moderate effect (Cohen’s d = 0.69), based on effect sizes reported in a previous study of neurocognitive functioning among youth with disordered eating (Allen et al., 2013). Because the primary comparisons of interest concerned OW-LOC and OW-CON, effect sizes and power calculations were based on these two groups.

Participants were recruited from the community via flyers distributed throughout The University of Chicago Medicine and surrounding areas, and from direct pediatrician referrals. Particip-ants were excluded if they had medical conditions or were taking medications known to influence weight or appetite; met criteria for an eating disorder other than binge eating disorder (BED); or had a diagnosis of attention deficit-hyperactivity disorder (ADHD). Interested individuals completed a phone screen to assess basic study entry criteria, and eligible participants were invited to attend a study visit, along with a parent or guardian, in the Department of Psychiatry and Behavioral Neuroscience at The University of Chicago Medicine. Each participant and his/her caregiver provided written informed assent/consent, respectively. Study procedures were approved by The University of Chicago Institutional Review Board.

2.2. Measures

2.2.1. Anthropometric and sociodemographic variables

Height and weight were measured in light indoor clothing by a trained research assistant via stadiometer and calibrated digital scale, respectively. Child z-BMI was calculated using CDC growth charts and accompanying procedures (Kuczmarski et al., 2000).

Demographic data were reported by children and parents, and
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