



The moderating effect of self-efficacy on normal-weight, overweight, and obese children's math achievement: A longitudinal analysis



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ABSTRACT

Increased body weight is associated with decreased cognitive function in school-aged children. The role of self-efficacy in shaping the connection between children's educational achievement and obesity-related comorbidities has not been examined to date. Evidence of the predictive ability of self-efficacy in children is demonstrated in cognitive tasks, including math achievement scores. This study examined the relationship between self-efficacy and math achievement in normal weight, overweight, and obese children. I hypothesized that overweight and obese children with higher self-efficacy will be less affected in math achievement than otherwise comparable children with lower self-efficacy. I tested this prediction with multilevel growth modeling techniques using the ECLS-K 1998–1999 survey data, a nationally representative sample of children. Increased self-efficacy moderates the link between body weight and children's math achievement by buffering the risks that increased weight status poses to children's cognitive function. My findings indicate that self-efficacy moderates math outcomes in overweight, but not obese, children.

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The number of American children classified as obese has sharply risen in recent years (Ogden et al., 2012; Wang et al., 2013). Approximately 17% of children aged 2 to 19 years-old are classified as obese [i.e., have a body mass index (BMI) above 30 kg m⁻²; (Ogden et al., 2014)]. There are, however, large disparities in childhood obesity prevalence between racial and ethnic minority groups, and by geographic location, with the highest incidence among Hispanic children (Ogden et al., 2014) and in children residing in the southeast region of the United States (Gopal et al., 2010; Befort et al., 2012). One population at risk is low-income elementary-aged children (Kopelman, 2007), an already vulnerable group whose rates of obesity have steadily increased across all races except Asians/Pacific Islanders, irrespective of gender (Kopelman, 2007). Socioeconomic inequality is associated with geographically concentrated childhood obesity among low-income groups that may lead to an accumulation of disadvantage for children throughout their life course (Giskes et al., 2008; Power et al., 2003; Woolf and Aron, 2013, p. 233).

The consequences of poor physiological and psychological

health extend to the academic domain. An overweight or obese child may succumb to anxiety and depression as a result of social marginalization and/or peer discrimination due to the stigma associated with being overweight, and, consequently, her math performance may suffer. For example, overweight and obese adolescents are more socially isolated and have fewer friendships than those of normal weight (Strauss and Pollack, 2003). This may then lead to devastating outcomes associated with psychological instability, and, in some cases, lowered academic performance (Robinson, 2006).

Increased body weight is associated with decreased cognitive function in school-aged children (Li et al., 2008). Researchers have shown that overweight and obesity in children is associated with deficits in executive function, which relies on proper functioning of the part of the brain responsible for planning and judgment (Cserjesi et al., 2007; Braet et al., 2007). Poor math performance, for example, could be due to ineffective planning or the inability to shift from one mental state to another, update working memory, or inhibit impulsive behavior (St Clair-Thompson and Gathercole, 2006). Given that the pathophysiological process of weight-associated complications culminates in cognitive decline and is driven by neural, cardiovascular, endocrine, musculoskeletal, renal,

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gastrointestinal, and pulmonary system malfunction, in addition to psychosocial problems (Kamijo et al., 2014; Garver et al., 2013), childhood obesity trends have implications for children's well-being in both the short and long term, including academic outcomes (Daniels et al., 2005; Freedman et al., 2007; see Taras and Potts-Datema, 2005, for review). Importantly, academic outcomes are not driven solely by cognitive capacity (Bandura, 1993), a limited pool of energy, resources, or fuel by which some cognitive processes are mobilized and maintained (Johnston and Heinz, 1978, p.422). Psychological resources such as optimism, personal control and a sense of meaning are protective for mental health (Frankl, 1963; Taylor, 1989; Seligman, 1998; Taylor et al., 2000), and these learned behaviors also assist children in educational achievement (Kolb, 1984; Zimmerman, 1989; Casey et al., 2005). Among these psychological resources, self-efficacy—typically conceptualized as perceived judgments of one's capabilities to organize and execute courses of action to attain chosen goals (Bandura 1977)—has consequences for children's psychological development, educational outcomes, and reproduction of stratification across generations (see Multon et al., 1991 for review; Schunk, 1995; Schunk and Pajares, 2004). The role of self-efficacy in shaping the connection between children's math achievement and obesity-related comorbidities has not been examined to date.

Perceived self-efficacy is the foundation of human motivation (Bandura, 1993, 1994, 2006). At the individual level, symbolic processes through which knowledge is formed may be analyzed as contributing to the production of individual differences in development (Dannefer, 1984). For example, the expectations communicated to, and interpreted by, a child, contribute to self-definition and to her plan of action. Bandura, and other social psychologists, suggest that individual action is driven by the core belief that we can produce desired results through our behavior. Self-efficacy moderates the effect of gender and prior experience on self-concept and mathematical problem solving (Pajares and Miller, 1994). It is also becoming evident that self-efficacy may be an important mechanism in the treatment of obesity (Clark et al., 1991; Linde et al., 2006). In the present study, I examined the relationship between self-efficacy and math achievement in normal weight, overweight, and obese children.

As a measure of cognitive function, I used math achievement, and not literacy, scores from kindergarten to eighth grade, because past research indicates that stress associated with variations in physical appearance can decrease math performance in adults (Fredrickson et al., 1998; Gable et al., 2012). Also, self-efficacy has been shown to predict math performance for undergraduate college students (Siegel et al., 1985). I hypothesized that children with consistently heightened BMI scores will have lower math achievement, compared to those of children with lower BMI (Gable et al., 2012).

Further, self-efficacy has previously been shown to serve as a moderator of weight management (Bandura, 2000), life stressors (Bandura, 1994), and scholastic aptitude (Brown et al., 1989). Because self-efficacy engenders a wide range of capacities and skills that children may draw upon to support their math achievement—and potentially buffer the effects of increased weight on learning—I expected self-efficacy to factor into this linkage by moderating the extent to which children's increased weight status will affect their math achievement. Thus, I hypothesized that, compared to overweight and obese children with lower self-efficacy, those who are overweight and obese but have higher self-efficacy, would score better on math achievement assessments. I tested these hypotheses by applying multilevel growth modeling techniques (Singer and Willett, 2003) to data from the Early Childhood Longitudinal Study—Kindergarten class 1998–1999 (ECLS-K).

1. Background

1.1. Linking obesity and math achievement to self-efficacy

Early childhood health influences later life outcomes (Currie, 2009; Almond and Currie, 2010, 2011). The current study is predicated on the notion that weight-related comorbidities are associated with cognitive dysfunction. The negative association between obesity and cognitive function is well documented (Li et al., 2008; Shore et al., 2008; McLaren, 2007), as is the positive association between self-efficacy and academic outcomes (Zimmerman, 2000; Cowen et al., 1991; Bandura, 1997). However, the direct association between self-efficacy and math outcomes among normal weight, overweight, and obese children in the United States has never been examined.

There is no consensus on the causal effect of childhood obesity on standardized test scores and academic outcomes. Cross-sectional and longitudinal studies examining the association between academic achievement and obesity are inconsistent. Researchers have found no association (Kaestner et al., 2009), a negative association (Averett and Stifel, 2010), a mediation between obesity and self-esteem (Tereshakovec et al., 1994), obesity and externalizing behavioral problems (Crosnoe, 2007), and obesity and interpersonal skills (Klinitzke et al., 2012) in poor academic performance. Nonetheless, there is ample theoretical and empirical evidence indicating a likely connection. Thus, my conceptual model is that overweight and obesity in children affects cognitive function and is linked to learning, which in turn affects math academic outcomes.

Self-efficacy has emerged as an effective predictor of students' motivation and scholarship. Self-efficacious students contribute more in the classroom, work more assiduously, persevere longer, and have fewer disadvantageous reactions when faced with challenges (Bandura, 1997). Furthermore, measures of self-efficacy are highly correlated with achievement in academic work and persistence (Zimmerman, 2000). Evidence of the predictive ability of self-efficacy in children is demonstrated in cognitive tasks, including math performance (Cowen et al., 1991). For example, Schunk and Hanson (1985) found a positive association between perceived self-efficacy and rate of accurate arithmetic solutions. Thus, research to date clearly links self-efficacy and math achievement (Bandura, 1997; Schunk and Hanson, 1985; Pajares and Kranzler, 1995; Adeyinka et al., 2007). Increased self-efficacy may, then, condition the link between overweight or obesity and children's achievement by buffering (or minimizing) the risks that increased weight status poses to children's math performance.

2. Data and methods

2.1. Data and sample

Analyses are based on the Early Childhood Longitudinal Study—Kindergarten class 1998–1999 (ECLS-K), a nationally representative sample of 21,260 children from kindergarten to eighth grade, conducted by the U.S. Department of Education, National Center for Education Statistics (NCES), and designed to study the development of educational stratification among American school children (West et al., 2000). Participants were selected using a multi-stage sampling design. For a more detailed description of the ECLS-K study design see, Tourangeau et al. (2009).

2.2. Inclusion criteria

Because “missingness” increased over time due to attrition in the ECLS-K data, I estimated my models using full information

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