



Overweight and obese infants present lower cognitive and motor development scores than normal-weight peers



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ABSTRACT

Aims: Compare the cognitive and motor development in overweight/obese infants versus normal-weight peers and investigate the correlation of body weight, body length and body mass index with cognitive and motor development.

Methods: We conducted a cross-sectional study with 28 overweight/obese infants and 28 normal-weight peers between 6 and 24 months of age. Both groups were evaluated with cognitive and motor scales of the Bayley-III infant development test. The *t*-test for independent samples was performed to compare the groups, and the Spearman correlation was used to verify the association between variables.

Results: Overweight/obese infants showed lower cognitive and motor composite scores than their normal-weight peers. A significant negative association was found of body weight and body length with cognitive development and of body mass index with motor development.

Conclusion: This is the first study that found an effect on both cognitive and motor development in overweight/obese infants when compared with normal-weight peers between 6 and 24 months of age.

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What this paper adds?

The literature has shown that overweight or obese children in preschool and elementary school present decreased cognitive and motor performance. This was the first study to compare cognitive and motor development in overweight/obese infants and normal-weight peers matched by gender, age, socioeconomic status, maternal education and exclusive breastfeeding until 6 months of age.

We demonstrated that overweight/obese infants presented lower cognitive and motor development scores than normal-weight infants between 6 and 24 months of age. The difference between groups was moderate, indicating that overweight/obese infants do not have important and cognitive impairments like infants with motor disabilities. However, their impairments may well be more subtle and less catastrophic, but can have a negative impact on school age. Moreover, inverse associations of body mass index with motor development, and body weight and body length with cognitive development were found.

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1. Introduction

The increasing prevalence of childhood obesity is one of the world's most serious public health issues (Sabin, Kao, Juonala, Baur, & Wake, 2015). In the last decades, overweight and obesity is increasing in very young children, including infants (Kim et al., 2006). According WHO, infants with body mass index (BMI) ≥ 97 th and < 99 th percentile are considered overweight and infants with BMI ≥ 99.9 percentile are obese (WHO Multicentre Growth Reference Study Group, 2006). In 2011–2012, 8.1% of infants and toddlers from birth to 2 years of age were considered obese in the United States (Ogden, Carroll, Kit, & Flegal, 2014). In Brazil, 6.5% of children younger than 2 years of age are overweight or obese (Cocetti, Taddei, Konstantyner, Konstantyner, & Barros Filho, 2012). The excessive accumulation of adipose tissue is associated with poor health outcomes due to several metabolic and cardiovascular complications throughout life (Sorisky, Molgat, & Gagnon, 2013). Moreover, excess weight may limit cognitive and motor development in childhood (Castetbon & Andreyeva, 2012; Miller & Spencer, 2014; Mond, Stich, Hay, Kraemer, & Baune, 2007; Nervik, Martin, Rundquist, & Cleland, 2011; Reinert, Po'e, & Barkin, 2013).

In regard to cognitive aspects, studies have shown overweight or obese children in preschool and elementary school have a lower performance on cognitive tests that can affect the children's school outcomes and persist throughout life (Datar & Sturm, 2006; Miller & Spencer, 2014; Reinert et al., 2013). However, confounding factors such as environmental stimuli, parental education and feeding practices can interfere with cognitive function in childhood. When confounding factors are controlled, no significant association is found between body mass index (BMI) and cognitive ability (Cai et al., 2015; Gibbs & Forste, 2014; Veldwijk, Scholtens, Hornstra, & Bemelmans, 2011).

Excess weight may also hinder children's movement and normal levels of activity and thereby compromise motor development (Schmidt Morgen et al., 2014). Most studies have shown an inverse relationship between BMI and gross and fine motor development in preschool, elementary and middle school children (Castetbon & Andreyeva, 2012; D'Hondt, Deforche, De Bourdeaudhuij, & Lenoir, 2008; Mond et al., 2007; Nervik et al., 2011). Factors such as gender, age and socioeconomic status may also interfere with this outcome (Castetbon & Andreyeva, 2012; Grantham-McGregor et al., 2007; Mond et al., 2007; Slining, Adair, Goldman, Borja, & Bentley, 2010; Taanila, Murray, Jokelainen, Isohanni, & Rantakallio, 2005).

Most studies evaluated children starting from 3 years of age, and there is only one known study that investigates the relationship between overweight infants and motor development (Slining et al., 2010). These authors conducted a longitudinal study with infants between 3 and 18 months of age and found motor delay was 1.80 times as likely in overweight infants compared with non-overweight infants. However, cognitive development has not been investigated.

Because the most rapid brain changes occur during the first 2 years of life (Johnson, 2001), this time interval represents the critical period in cognitive and motor development (Taanila et al., 2005). The brain develops rapidly and small perturbations in these processes can have long-term effects on the brain's structural and functional capacity (Grantham-McGregor et al., 2007). Thus, evaluating whether excess weight during infancy affects cognitive and motor development is important.

No study to date has evaluated the cognitive and motor development of infants between 6 and 24 months of age with control of confounding variables such as gender, socioeconomic status, maternal education and duration of exclusive breastfeeding. Thus, the objectives of this study were 1) to compare the cognitive and motor development in overweight/obese infants versus normal weight peers matched for gender, age, socioeconomic status, maternal education and exclusive breastfeeding until 6 months of age and 2) to investigate the association of anthropometric variables (BMI, body weight and body length) with cognitive and motor development in this age interval. We hypothesized that overweight/obese infants will have lower cognitive and motor development scores when compared to normal-weight peers and that there will be an inverse relationship between anthropometric variables and cognitive and motor development.

2. Method

2.1. Participants

Fifty-six infants aged between 6 and 24 months participated in this study. The overweight/obese group included infants with BMI ≥ 97 th percentile (z score $> +2$). For each overweight/obese infant, a normal-weight peer was matched for gender, age, socioeconomic status, maternal education and duration of exclusive breastfeeding. These participants were recruited from registration data from Family Health Strategies. Normal-weight peers had to have BMI ≥ 3 and < 85 th percentile (z score > -2 and $< +1$). These participants were classified on the basis of the World Health Organization (WHO) Child Growth Standards from 0 to 5 years, according to the BMI-for-age cut-off points relative to age and gender (WHO Multicentre Growth Reference Study Group, 2006; de Onis & Lobstein, 2010). Exclusion criteria were: preterm and low birth weight infants; infants with pregnancy and delivery complications; infants with signs of malnutrition or illness that interfere with growth and development; and infants who had some infectious process (fever, influenza, diarrhea, ear infections, etc.) in the past 15 days.

Because of the lack of studies in this age interval, a pilot study was initially conducted with 11 children in each group to calculate the sample size. A minimum difference of 1.27 between the groups and an SD of 2.38 for cognitive composite score were considered. Thus, 28 participants were required for each group.

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