

Breastfeeding, gross motor development and obesity, is there any causal association?

Lactancia materna, desarrollo motor y obesidad, ¿Existe asociación causal?

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Abstract

Childhood obesity is the main nutritional and public health problem in Chile, being the principal causes, the increase in energy dense foods and the decline of physical activity. Interventions to prevent obesity at infancy are focused mainly in improving quality and quantity of dietary intake, without taking into account physical activity, which is expressed under two years of age, mainly by motor development. Some studies have proven that motor development at early age, may influence the ability to perform physical activity. Thus, infants scoring a lower motor development may have a greater risk of becoming obese. It isn't know if childhood obesity causes lower motor development (given that children may have greater difficulty to move), or on the contrary, it is the lower ability to move, which increases the obesity risk. The objective of this manuscript is analyze the evidence regards the relation between breastfeeding, motor development and obesity in the childhood. To be able to understand this association and casual mechanism, it is important to develop strategies focused in early infancy to promote breastfeeding, healthy eating and early stimulation, starting in pediatric office.

Keywords:

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Introduction

Obesity is one of the most common public health problems in Chile and in the world, caused by the bad dietary habits and the increase in sedentary lifestyle¹. It has been proven that the prevalence of overweight and obesity starts and increases since an early age². The rapid weight gain between 3 and 6 months of age seems to be a powerful predictor of overweight and subsequent metabolic risk³, therefore children who have a higher body mass index (BMI) in their first months of life have a greater risk of being overweight at 7 years⁴, also in a long-term, they have higher risk to be obese in adulthood^{5,6}.

There are several factors that may modulate an infant's risk of being obese at a later stage⁷. It should be considered, among other things, genetic and environmental variables, such as breastfeeding (BF) and complementary food, diseases, physical activity, socio-cultural level, stimulation at home and even their personality and mood⁸.

Lately, during the last 10 years, obesity in school-children has increased in a 30% in our country, reaching 24.2% in children who start the primary school⁹. On the other hand, we must consider that there is a low prevalence of exclusive BF, which it reaches a 44.5% at the sixth month of life¹⁰, in addition to the poor consumption of healthy foods¹¹. Regarding physical activity, the last National Survey of Physical Activity and Sports Habits showed that an 80% of the adult population is sedentary¹², and according to data from the Ministry of Education, more than 90% of children during primary school have a poor physical condition¹³, while preschoolers spend 60% of their time on passive activities¹⁴.

Recent papers shows that obese children have less motor development, which may be linked to their physical competence in their future¹⁵. From this, it is important to highlight that the 14.4% of the children attended in the private health system and 30.4% of children attended in the private system have developmental delay¹⁶, predominating gross motor difficulties on the infant group¹⁷.

The purpose of this study is to analyze the evidence that may associate BF with motor development and obesity in childhood, in order to contribute to develop prevention strategies from an early age.

Breastfeeding and obesity

Eating routine is recognized as one of the most important conditions that leads to excess adiposity in children¹⁸, especially during their first year of life. Both,

the exclusive BF and sufficient complementary feeding (in quality and quantity) are some factors that promote adequate growth and physical composition¹⁹.

Although there is not a substantial effect, BF has been shown to be a factor which protects the child from obesity in the long term^{20,21}, with a dose-response effect according to its duration²².

Regarding prolonged BF, it is directly associated with a lower percentage of body fat in adulthood due to its effect on growth and body adiposity in infancy²³. Gale C et al., in a meta-analysis about physical composition and types of feeding in infants, found that those children fed with BF had lower fat mass at 12 months, compared to those fed with formula, or complementary feeding²⁴.

Dewey K. reported that BF-infants tend to be slimmer than Formula feed infants (who were fed with complementary feeding during their second stage of childhood), all this due to their self-regulation of appetite and energy intake²⁵. Complementary feeding with formula and the introduction of solid foods before four months of age increases the risk of children becoming obese by age three²⁶. Some studies state that early feeding experiences are associated with accepting or rejecting different flavors of foods, such as fruits and vegetables. Accordingly, BF would ease the process of acceptance of such foods, as well as the introduction of new solid foods, as long as they have been regularly consumed by the mother. The regular and repeated exposure to a variety of flavors and colors would increase their consumption and acceptance, being the latter precisely the strongest determinant^{27,28}. Cohort studies have proved that there is a connection between increased intake of fruits and vegetables in children and adolescents in relation to a longer duration of BF²⁹.

Breastfeeding and psychomotor development

Although there is no established cause, there are studies that prove a linear "dose-response" association between the length of BF period and cognitive and psychomotor development³⁰. This relationship does not depend on the general characteristics of the child or their parents³¹⁻³³. Grace et al., in a cohort of 2,868 Australian children, showed that the relationship between BF and psychomotor skills remained at 10, 14 and 17 years of follow-up³⁴. However, Tozzi et al. in a cohort of 1,403 healthy children between 10 to 12 years old, reported that the effect of duration of BF on neurocognitive development had any clinical relevance, being mainly dependent on parental education³⁵.

Some of the explanations for these associations may be the amount of essential polyunsaturated fatty acids (PUFA) in breast milk³⁶, as well as the warning

level that mothers might have in order to detect any psychomotor problem of their children and a greater orientation and stimulus to the development of the infant³⁷.

Early motor development and obesity

Physical activity and sports provide several health benefits. Physical condition in childhood and adolescence is vital for their present and future health, with an inverse relationship between physical activity, central adiposity and cardiovascular risks³⁸.

It seems to be known that motor domain in childhood is inversely associated with the sedentary lifestyle³⁹ and the improvement of aerobic capacity in adolescents⁴⁰, so it could be a protection for obesity, indirectly. In a Finnish cohort, Ridgway et al. described that early developmental achievements, such as walking or standing without support, were important predictors of sports participation at around 14 years old, as well as increasing their muscle strength and aerobic capacity during adulthood^{41,42}. Barnett et al. showed in a systematic review that in children from 3 to 18 years old, that the correlation between development and physical capacity depends on which is the development dimension evaluated, finding that there is a positive correlation with coordination, without being able to determine the association with other gross motor skills⁴³.

Regarding motor development and obesity, the evidence is even less obvious, and it is difficult to establish that there is a causal relationship. Currently, it is accepted to think that an infant is overweight because they move less and have worse physical condition in the long term, or that those who later acquire motor skills, such as independent walking, would tend to a higher BMI. Table 1 summarizes the articles that analyze the relationship between motor skills development and obesity. You would be able to observe great heterogeneity between the methodologies and ages evaluated.

There are some studies which conclude that overweight and obese children have lower cognitive and motor skills development. These conclusions are due to the use of standardized tests, measuring development coefficients⁴⁴⁻⁴⁸, while other studies question this association based on the age of acquisition of some gross motor skills, related to the acquisition of independent gait⁴⁹⁻⁵¹.

Other authors have studied the relationship among anthropometry, motor skills and physical activity in preschoolers and schoolchildren. When comparing

children with high BMI versus eutrophic, Nervik D et al. reported that the former have more difficulties in their gross motor skills at the age of 3 and 5 years old⁴⁷, and according to D'Hondt E et al., they would have lower motor coordination skills between 6 and 10 years of age⁵².

Cheng and Cols, in a cohort of 668 healthy children in the city of Santiago de Chile, investigated the temporal relationship between the acquisition of gross motor skills and the anthropometric evolution. These authors reported that the highest BMI at 5 years of age was associated with lower motor proficiency between the ages of 5 and 10 years old; however, lower motor skills at 5 years were not related to a higher BMI, which suggests that obesity is a predictor of lower physical capacity, but not vice versa⁵³.

Conclusions

Childhood obesity and sedentary lifestyle are very important problems in the public health system in our country. Although the scheme is not yet clear, there are several studies supporting the hypothesis that BF protects against obesity and, at the same time, promotes children's complete development, with a "dose-response" relationship. Considering that the development of motor skills is one of the many items conditioning sports participation in the future (with the obesity's long-term protective effect), to promote the evolution of children is a responsibility that goes beyond fulfilling what is considered 'Normal' (Figure 1). It seems that evidence is increasingly inclined to support a kind of relationship between early motor skills' development and physical composition, even though it is not complete, probably due to the wide heterogeneity of available studies and the lack of longer-term prospective investigations (Table 1).

Regarding the treatment of childhood obesity, results remain very poor. Additional efforts are needed to fight against this epidemic of the 21st century. In order to prevent overweight, main precautions should be initiated at an early stage⁵⁴, from the earliest pediatric health supervision activities, reinforcing healthy habits, not only related to food, but also in physical activity and motor skills development.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

Table 1. Analysis of studies analyzing the association between motor development and obesity

Author	Country, year	Study design	Sample characteristics	Measure instrument	Objective	Results
Articles supporting the association between obesity and gross motor development in infants						
Camargos ACR et al. ⁴⁴	Brazil, 2016	Cross-sectional	28 Ow/Ob infants and 28 normal-weight peers between 6 and 24 months of age	Bayley-III	1) Compare the cognitive and motor development in overweight/obese infants versus normal-weight peers 2) To investigate the correlation of body mass index with cognitive and motor development.	Ow/Ob infants showed lower cognitive and motor composite scores than their normal-weight peers: Cognitive composite score 100.89 + 9.72 vs 106.25 + 8.35, p 0.03 Motor composite score 96.43 + 10.75 vs 102.14 + 9.386, p 0.04 A significant negative association was found of BMI with motor development (r = 0.29, p 0.03)
Andres A et al. ⁴⁶	USA, 2013	Prospective, longitudinal cohort study	469 infants were assessed at 3, 6, 9, 12, and 24 months of age	Bayley-II	To characterize total body fat mass and motor development during the first 2 years of life in healthy infants	There is negatively relationship between total body FM and PDI scores was significant starting at 9 months Infants with high total body FM ($\geq 31\%$) scored 1.96 points lower on concurrent PDI and 3.05 points lower on subsequent PDI. Neither anthropometric measures nor total body FM was associated with the clinical diagnosis of delayed motor development
Nervik D et al. ⁴⁷	USA, 2011	Cross-sectional	50 children who were healthy aged 3 to 5 years	Peabody Developmental Motor Scales, 2nd edition (PDMS-2)	To investigate the relationship between Ow and gross motor development in children who are developing typically and determine whether body mass index (BMI) predicts difficulty in gross motor skills	58% of the Ow/Ob group scored below average compared to 15% of the nonoverweight group. Association between BMI and gross motor quotients was identified significant (p 0.002)
Slining M et al. ⁴⁸	USA, 2010	Prospective, longitudinal study	217 infant of low-income assessed from 3 to 18 months of age	Bayley-II	To examine how infant Ow and high subcutaneous fat relate to infant motor development	Motor delay was 1.80 times as likely in Ow infants compared with non-Ow infants (95% CI, 1.09-2.97) and 2.32 times as likely in infants with high subcutaneous fat compared with infants with lower subcutaneous fat (95%CI, 1.26-4.29)
Shibli R. et al. ⁴⁵	Israel, 2008	Cross-sectional	79 infants with Ow/Ob and 144 infants in the control group	Parents of infants were interviewed by using a structured questionnaire that	To assess the prevalence of morbidity in Ow infants in a community-based sample	Ow infants had significantly more gross motor developmental delay problems 7/79 (8.9%) vs 1/144 (0.7), p 0.002

Articles that refute the association

Schmidt Morgen et al. ⁵⁰	Denmark, 2013	Prospective, longitudinal study	25,148 children born at term follow-up to 7 years old	Age of sitting and walking	1) To investigate whether increased birth weight and body mass index (BMI) at 5 months is associated with the achievement of the ability to sit up and walk 2) To investigate whether delayed achievement of these milestones is associated with overweight at age 7 years	BMI at 5 months were marginally associated with earlier achievement of the ability to sit up and walk (regression coefficients between -0.027 month and -0.092 months) Age in months of sitting and walking were not associated with Ow at age 7 years (ORs between 0.97 [CI 0.95–1.00] and 1.00 [CI 0.96–1.04]). Later achievement of sitting and walking predicted lower BMI at age 7 years (ln-BMI –z-scores between -0.023 [CI -0.029; -0.017] and -0.005 [CI -0.015; 0.005])
Neelon et al. ⁵¹	USA, 2012	Prospective, longitudinal study	741 mother/infant dyads follow up for 3 years	Age of attainment of 4 gross motor milestones-rolling over, sitting up, crawling, and walking	To examine associations of age of achievement of gross motor milestones in infancy with adiposity at age 3 years	None of the milestones were associated with BMI z-score. Age of motor milestone achievement was only a modest predictor of adiposity
WHO Multicentre Growth Reference Study Group ⁴⁹	Multi-centre, 2006	Prospective, longitudinal study	816 children included in the WHO Child Growth Standards.b follow-up until children could walk alone or reached 24 month	Age of achievement of Six gross motor milestones: sitting without support, hands-and-knees crawling, standing with assistance, walking with assistance, standing alone, walking alone)	To examine relationships among physical growth indicators and ages of achievement of six gross motor milestones	Sporadic, significant associations were observed between gross motor development and some physical growth indicators

Ow/Ob= overweight/obese; BMI= body mass index; FM= Fat Mass. Bayley-II: Bayley Scales of Infant Development 2^a edition; Bayley-III: Bayley Scales of Infant and Toddler Development, 3rd edition.

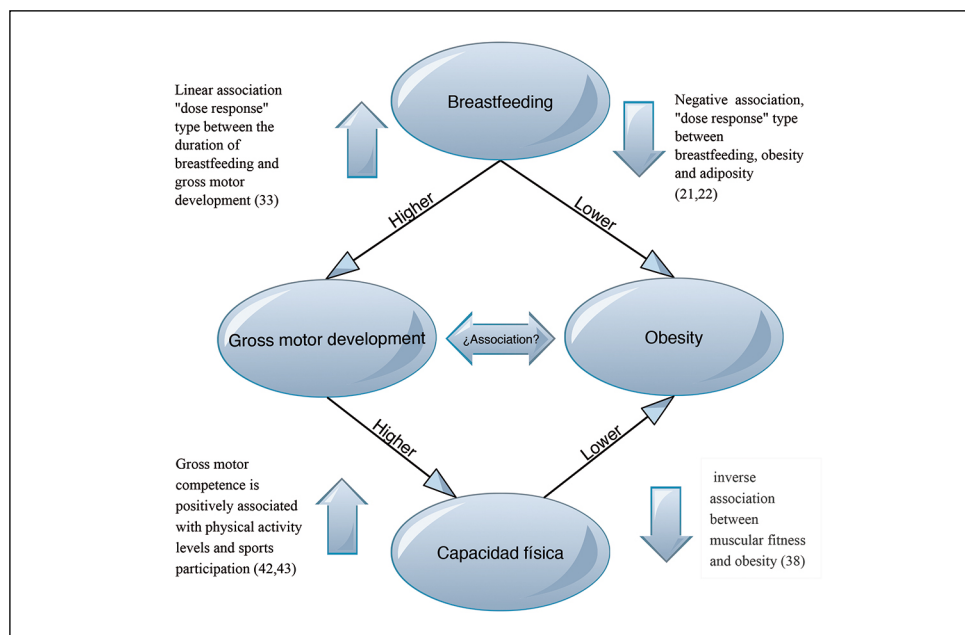


Figure 1. Relationship between breastfeeding, motor development, physical activity and obesity.

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