

Exclusive breastfeeding and adiposity

Aleitamento materno exclusivo e adiposidade

Amamantamiento materno exclusivo y adiposidad

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ABSTRACT

Objective: To associate exclusive breastfeeding with central and peripheral adiposity measured by body mass index, waist and arm circumferences, triceps and subscapular skinfolds and their sum in preschool children.

Methods: This cross-sectional study enrolled 134 preschool children aged 3-5 years from a private school in Brasília, Brazil. All children had their body weight, height, waist and arm circumferences, and triceps and subscapular skinfolds measured. Children's parents answered a questionnaire about breastfeeding duration. Overweight and obesity were diagnosed based on the World Health Organization's classification for the body mass index for age.

Results: Girls had higher adiposity in the triceps skinfold ($p=0.001$), subscapular skinfold ($p=0.044$) and in their sum ($p=0.003$), when compared to boys. Prevalence of overweight and obesity was similar between genders (25.4% for boys and 22.6% for girls), as it was exclusive breastfeeding (4.3 months for boys and 4.6 months for girls). A significant inverse correlation was found only between exclusive breastfeeding and waist circumference ($r=-0.166$; $p=0.05$). Other anthropometric variables showed a trend to present an inverse correlation with exclusive breastfeeding, but lacked statistical significance.

Conclusions: The significant inverse association between exclusive breastfeeding and waist circumference indicates a possible effect of breastfeeding in body fat distribution in preschool children.

Key-words: breastfeeding; adiposity; obesity, abdominal; child, preschool.

RESUMO

Objetivo: Associar o tempo de amamentação exclusiva da criança à adiposidade central e periférica, por meio do índice de massa corporal, dos perímetros da cintura e do braço, e das dobras cutâneas tricipital, subescapular e a somatória destas em pré-escolares.

Métodos: Pesquisa de delineamento transversal, em que 134 pré-escolares entre três e cinco anos de idade de uma escola particular de Brasília, DF, foram avaliados quanto a: massa corporal, estatura, perímetros do braço e da cintura, dobras cutâneas tricipital e subescapular. Os pais das crianças responderam a um questionário sobre tempo de amamentação. O diagnóstico de sobrepeso e obesidade foi realizado de acordo com a classificação da Organização Mundial da Saúde para o índice de massa corporal por idade.

Resultados: As meninas tiveram maior concentração adiposa na dobra cutânea tricipital ($p=0,001$), subescapular ($p=0,044$) e na somatória destas ($p=0,003$) em relação aos meninos. A prevalência de sobrepeso e obesidade foi similar nos dois sexos (25,4% nos meninos e 22,6% nas meninas), assim como o tempo médio de amamentação exclusiva (4,3 meses para meninos e 4,6 meses para meninas). Notou-se correlação inversa significativa entre tempo de amamentação exclusiva e perímetro da cintura ($r=-0,166$; $p=0,05$). As demais variáveis também mostraram tendência de correlação inversa com o tempo de aleitamento materno exclusivo, porém sem valores significativos.

Conclusões: A associação inversa entre o tempo de amamentação e o perímetro da cintura mostra um possível efeito do aleitamento materno sobre a distribuição de gordura corporal no pré-escolar.

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Palavras-chave: aleitamento materno; adiposidade; obesidade abdominal; pré-escolar.

RESUMEN

Objetivo: Asociar el tiempo de amamantamiento exclusivo del niño con la adiposidad central y periférica mediante el índice de masa corporal, perímetros de la cintura y del brazo, y pliegues cutáneos tricípital, subescapular y la suma de estos en pre-escolares.

Métodos: Investigación de delineación transversal, en la que 134 pre-escolares entre 3 y 5 años de edad de una escuela privada de Brasilia, Brasil, fueron evaluados respecto a: masa corporal, estatura, perímetros del brazo y de la cintura, pliegues cutáneos tricípital y subescapular. Los padres de los niños contestaron a un cuestionario sobre el tiempo de amamantamiento. El diagnóstico de sobrepeso y obesidad fue realizado conforme a la clasificación de la Organización Mundial de la Salud para el índice de masa corporal por edad.

Resultados: Las niñas tuvieron mayor concentración adiposa en el pliegue cutáneo tricípital ($p=0,001$), subescapular ($p=0,044$) y en la suma de éstos ($p=0,003$) respecto a los niños. La prevalencia de sobrepeso y obesidad fue similar en los dos sexos (25,4% en los niños y 22,6% en las niñas), así como el tiempo mediano de amamantamiento exclusivo (4,3 meses para niños y 4,6 meses para niñas). Se notó correlación inversa significativa entre tiempo de amamantamiento exclusivo y perímetro de la cintura ($r=-0,166$; $p=0,05$). Las otras variables también mostraron tendencia de correlación inversa con el tiempo de amamantamiento materno exclusivo, pero sin valores significativos.

Conclusiones: La asociación inversa entre el tiempo de amamantamiento y el perímetro de la cintura muestra un posible efecto del amamantamiento materno sobre la distribución de grasa corporal en el pre-escolar.

Palabras clave: amamantamiento materno; adiposidad; obesidad abdominal; pre-escolar.

Introduction

The increase in childhood obesity over the past two decades has raised a series of hypotheses regarding the reasons that trigger this process. Setian *et al*⁽¹⁾ report that the development of obesity could be caused by an imbalance between caloric intake and energy expenditure, or be

determined by genetic, pathophysiological (endocrine-metabolic), environmental (eating habits and physical activity) and psychological factors.

In this regard, several studies have sought to relate obesity with environmental variables that influence the lives of children. Among these variables is breastfeeding, which, in addition to improving the neurological, visual, and psychosocial development and protecting against various morbidities⁽²⁾, is mentioned as a protective factor against the development of overweight and obesity in several studies⁽³⁻⁷⁾.

The early diagnosis of overweight and obesity can help prevent and combat excess weight and prevent the development of cardiovascular disease and degenerative diseases associated with it, such as atherosclerosis, glucose intolerance, diabetes mellitus type 2, dyslipidemia and hypertension⁽⁸⁾. The recent release of the new child growth standards, by the World Health Organization (WHO), which include, along with weight and height, indicators such as arm circumference and triceps and subscapular skinfolds⁽⁹⁾, facilitates the diagnosis and assessment of adiposity in children.

Thus, the present study is based on the assumption that children exclusively breastfed for longer periods would have lower measures of adiposity, considering the protective factor of breast milk against the development of overweight and obesity⁽³⁻⁷⁾. Therefore, the aim of the study was to evaluate possible associations between the duration of children's exclusive breastfeeding, body mass index (BMI) and central and peripheral adiposity, through the waist and arms circumferences, triceps and subscapular skinfold, and the sum of these measurements, in preschool children at a private school in Brasília, Brazil.

Method

Sample consisted of 134 preschool children aged between three and five years, enrolled in Centro Educacional Católica de Brasília (CECB), a private school in Brasília, Brazil. The school has about 3.500 students, 330 of which are aged between three and five years, and is predominantly middle class and upper middle class, with classes ranging from early childhood education until the end of high school.

In one single meeting (cross-sectional study), the children were assessed for weight, height, waist circumference, arm circumference, and triceps and subscapular skinfolds on the left side, according to the guidelines proposed by the WHO standard⁽¹⁰⁾. All children aged between three and five years were invited to participate in the study, with

the precondition of parents answering a questionnaire including questions about breastfeeding (exclusive and complementary) and signing an informed consent form. The research was approved by the Ethics Committee for Research of Universidade Católica de Brasília (UCB).

Body mass was measured using a Filizola scale (São Paulo, Brazil), with 100g accuracy. Height was measured using a Gofeka stadiometer (Santa Catarina, Brazil) with a 0.1cm accuracy. Arm and waist perimeters were measured with a Cescorf® inextensible anthropometric measuring tape (Rio Grande do Sul, Brazil) with 0.1cm accuracy. The measurement of waist circumference was performed with the children in the upright position, at the midpoint between the last rib and iliac crest. The subscapular and triceps skinfolds were measured with a Lange skinfold caliper (Maryland, USA) with 0.5mm accuracy. The triceps fold was measured at the midpoint between the olecranon and the acromion of the left arm, and the subscapular fold just below the subscapularis and inferior angle of left scapula.

Children were diagnosed as thin, normal, overweight or obese, according to the z-scores recommended by the World Health Organization⁽¹¹⁾ and enforced by the Ministry of Health, through the use of software Anthro and Anthroplus.

Sample size was calculated according to the equation to estimate samples in a finite population⁽¹²⁾, and the confidence level was set at 95%, which corresponds to a value of 1.96 expressed in standard deviations numbers; the percentage by which the phenomenon takes place is fixed at 16.6%, once the children included in the study could be exclusively breastfed for one month until their six months of life; the total population for the analyzed school was 330 students aged three to five years, and the sampling error was set at 5%. According to this calculation, the necessary sample for this study was 130 children.

For comparisons between anthropometric measurements and the prevalence of overweight and obesity, according

to sex, the Student's t-test for independent samples was used. The Pearson correlation was used to analyze the relationship between the duration of breastfeeding and the anthropometric variables, using SPSS® 15.0 for Windows, and the degree of significance was set at $p < 0.05$. The power calculation was performed with the aid of the G*Power 3.0.10 software, and it reached values of 0.81 for the mean comparison test and 0.95 for the correlation test.

Results

Of the 134 children studied, 71 were female and 63 male, 20.1% (n=27) were three years old, 37.3% (n=50) were four years old and 42.5% (n=57) were five. Table 1 shows the general characteristics of children. Student's T-test for independent samples indicated a significant difference between sexes for the triceps skinfold ($p=0.001$), subscapular skinfold ($p=0.044$) and for the sum of both skinfolds ($p=0.003$), with girls showing greater adiposity than boys.

Overweight and obesity were identified in 23.8% (n=32) of preschool children, with 25.4% (n=16) of cases affecting boys and 22.6% (n=16) affecting girls. Thinness was detected in only one child (0.7%). There were no significant differences in the frequency of overweight between the sexes and different age groups (Table 2).

Mean duration of breastfeeding was 4.5 ± 1.6 months, without significant differences between the sexes. The frequency of overweight in children who were exclusively breastfed until they were sixth month old was 21.2%, whereas for those who were exclusive breastfed until their second month of life, the rate was 26.7%. The Pearson correlation between duration of children's breastfeeding and the anthropometric variables assessed showed an inverse association with all variables. The correlation was significant regarding waist circumference ($r = -0.166$; $p = 0.05$), as shown in Table 3 and Figure 1.

Table 1 - Anthropometric measurements of preschool children divided by sex. Mean values and standard deviation

	Girls	Boys	Total
Body Mass	17.8 (3.3)	18.5 (3.0)	18.1 (3.2)
Height	105.3 (7.5)	107.1 (6.9)	106.2 (7.3)
BMI	15.9 (1.5)	16.0 (1.7)	16.0 (1.6)
Arm circumference	16.8 (1.6)	16.7 (1.7)	16.8 (1.7)
Waist circumference	51.8 (4.9)	52.5 (4.3)	52.1 (4.6)
Triceps SF	9.0 (2.4)*	7.7 (1.8)	8.4 (2.3)
Subscapular SF	5.9 (2.0)*	5.3 (1.8)	5.6 (1.9)
Σ TSF and SSF	15.0 (4.1)*	13.0 (3.4)	14.1 (3.9)

* $p \leq 0.05$; BMI: body mass index; SF: skinfold; TSF: triceps skinfold; SSF: subscapular skinfold.

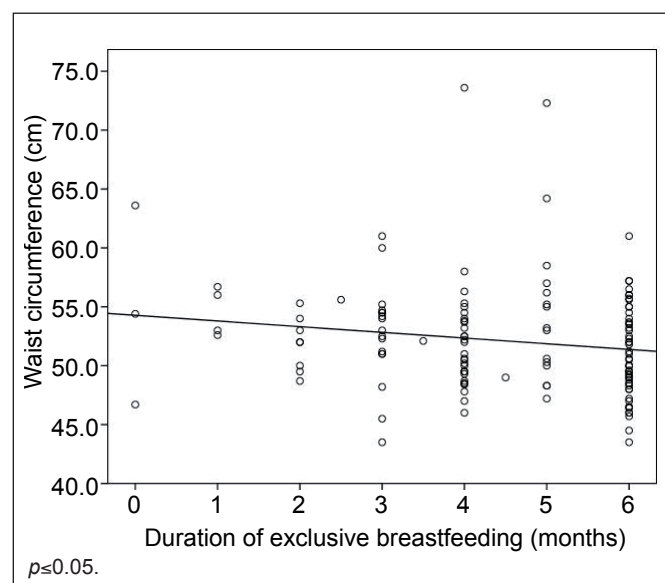
Table 2 - Frequency of thin, normal weight, overweight and obese preschoolers, based on BMI per age, according to the WHO classification⁽¹¹⁾

	Girls (%)	Boys (%)	Total (%)
Thinness	-	1 (1.6)	1 (0.7)
Normal weight	55 (77.5)	46 (73.0)	101 (75.4)
Risk of Overweight	7 (9.9)	8 (12.7)	15 (11.2)
Overweight	8 (11.3)	6 (9.5)	14 (10.4)
Obesity	-	2 (3.2)	2 (1.5)
Severe obesity	1 (1.4)	-	1 (0.7)

Table 3 - Pearson correlation between duration of exclusive breastfeeding (0-6 months) and anthropometric variables

	BMI	WC	AC	TSF	SSF	Σ SF
Breastfeeding	-0.088	-0.166*	-0.046	-0.074	-0.101	-0.091

* $p \leq 0.05$; BMI: body mass index; AC: arm circumference; WC: waist circumference; TSF: triceps skinfold; SSF: subscapular skinfold; ΣSF: sum of subscapular and triceps skinfolds.

**Figure 1** - Scatter plot between waist circumference and duration of exclusive breastfeeding.

Discussion

Numerous studies have associated the time of exclusive breastfeeding and the development of overweight and obesity. Particularly noteworthy are the studies by Siqueira and Monteiro⁽³⁾ Victora *et al*⁽⁴⁾, Koletzko *et al*⁽⁵⁾, Harder *et al*⁽⁶⁾, Shields *et al*⁽⁷⁾ Von Kries *et al*⁽¹³⁾ and Gillman *et al*⁽¹⁴⁾, which have found a dependent effect between the duration of breastfeeding and the incidence of overweight and obesity in children and adolescents. Bergmann *et al*⁽¹⁵⁾ have observed statistically higher values for subscapular and triceps skinfolds in artificially fed children.

Review studies and meta-analysis have also raised evidence that prolonged breastfeeding is associated with lower prevalence of obesity and a lower BMI compared to children and adolescents who consumed milk formula^(2,16,17). Owen *et al*⁽¹⁸⁾ have associated breastfeeding with low levels of insulin, preprandial blood glucose, pre- and post-prandial insulin, and an approximately 40% lower risk of developing type 2 diabetes mellitus. Martin *et al*⁽¹⁹⁾ reported an inverse association between breastfeeding and high blood pressure.

Moreover, the literature also shows studies that have found no association between breastfeeding and overweight. Li *et al*⁽²⁰⁾ have found no protective effect of breastfeeding on the development of obesity. Kramer *et al*⁽²¹⁾ have found no beneficial effects of prolonged exclusive breastfeeding on blood pressure, height, BMI, waist circumference, triceps and subscapular skinfolds. Burdette *et al*⁽²²⁾ have found no statistically significant results when comparing body fat through Dual-Energy X-Ray Absorptiometry (DEXA), with duration of breastfeeding or introduction of complementary feeding.

An inherent limitation of our study may have been the quantification of exclusive breastfeeding time through the use of questionnaires, which could lead to a bias of neglect by parents. Other studies in the literature, however, report the collection of this data by using the same instrument^(14,20). Additionally, our cross-sectional survey only allows for assessment of the degree of adiposity at a given time in the lives of children, thus suggesting the need for longitudinal studies in order to better monitor the growth and development of these children.

This study shows a trend toward a lower incidence of overweight and obesity in preschool children who were breastfed exclusively until the sixth month of life. Furthermore, we observed a significant inverse correlation between waist circumference and duration of breastfeeding. This result was also observed by Rudnick *et al*⁽²³⁾, in which individuals who were breastfed for more than a month had lower waist circumference, lower waist-hip ratio, and a 15% lower risk of developing

obesity, in addition to lower levels of inflammatory markers when compared to those breastfed for less than 30 days.

The importance of this finding is due to the known effect of visceral adiposity as a predisposing factor for developing chronic diseases such as arterial hypertension, dyslipidemia, metabolic syndrome, type 2 diabetes mellitus, and others⁽²⁴⁻²⁹⁾. This finding highlights a possible effect of breastfeeding on body fat distribution in childhood.

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