

Influência do peso ao nascer e do estado nutricional materno na composição corporal de escolares

Birth weight influence and maternal nutritional status in student's body composition

Influencia del peso al nacer y el estado nutricional materno en la composición corporal de los escolares

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Resumo

Objetivo: Avaliar a relação do peso ao nascer e do estado nutricional materno na composição corporal de crianças de 7 a 9 anos de idade. **Métodos:** Estudo transversal, constituído de levantamento de variáveis socioeconômicas e antropométricas dos entrevistados no qual foram avaliadas 41 crianças de ambos os sexos e suas respectivas mães na cidade de Picos – PI. Os seguintes parâmetros antropométricos maternos foram investigados: peso, altura e circunferência da cintura. Por sua vez, as seguintes variáveis antropométricas dos escolares foram coletadas: peso ao nascer e atual, estatura, circunferência da cintura (CC) e do braço (CB), além de dobras cutâneas subescapulares (DCSE) e tricípital (DCT). **Resultados:** O peso ao nascer se correlaciona positivamente e de forma significativa com algumas variáveis antropométricas das crianças, como: Circunferência da cintura (CC; $p=0,02$), circunferência do braço (CB $p=0,03$), Dobra cutânea subescapular (DCSE; $p=0,02$) e Percentual de gordura corporal (%GC; $p=0,05$). Verificou-se ainda uma correlação positiva estatisticamente significativa entre o peso atual da criança e o peso atual da mãe ($p=0,04$). Além disso, observou-se uma correlação baixa, mas significativa e inversa entre a altura da mãe com as variáveis referentes à composição corporal das crianças. **Conclusão:** O presente estudo sugere que o peso ao nascer correlaciona-se com a composição corporal atual das crianças, e que, independente do peso ao nascer, o peso materno correlaciona-se com o peso atual da criança,

demonstrando a importância da monitorização contínua do estado nutricional entre o binômio mãe-filho.

Palavras-chave: Antropometria; Nutrição da mãe; Desenvolvimento infantil.

Abstract

Objective: This paper aims to evaluate birth weight and maternal nutritional status in children's body composition aging from 7 to 9 years old. **Methods:** Transversal study composed of collecting interviewee's socio economic and anthropometrical variables in which 41 children and their mothers were evaluated in the city of Picos in Piauí state. The following mother's anthropometrical parameters were investigated: weight, height, and waist circumference. In addition, the following student's anthropometrical variables were collected: born and current weight, height, waist circumference (WC), arm circumference (AC), subscapular skinfold (SS), and triceps skinfold (TS). **Results:** Birth weight relates positively and significantly with some anthropometrical variables of children, such as: waist circumference (WC; $p=0.02$), arm circumference (AC; $p=0.03$), subscapular skinfold (SS; $p=0.02$), and percentage of body fat (%BF; $p=0.05$). A statistically positive correlation between children's current weight and mother's current weight ($p=0.04$) was observed. Besides, a lower, but more significant inverse correlation between mother's height and variables referring to children's body composition was found. **Conclusion:** The following paper suggests that born weight correlates with children's current bodily composition and that, no matter what the born weight is, mother's weight is relevant to the children's current weight, demonstrating the importance of continuous screening of nutritional status between mother and children.

Keywords: Anthropometry; Mother's nutrition; Infant's development.

Resumen

Objetivo: evaluar la relación entre el peso al nacer y el estado nutricional materno en la composición corporal de niños de 7 a 9 años. **Métodos:** Estudio transversal, consistente en una encuesta de variables socioeconómicas y antropométricas de los entrevistados en el que se evaluaron 41 niños de ambos sexos y sus respectivas madres en la ciudad de Picos - PI. Se investigaron los siguientes parámetros antropométricos maternos: peso, altura y circunferencia de la cintura. A su vez, se recogieron las siguientes variables antropométricas de los estudiantes: peso al nacer y peso actual, altura, circunferencia de la cintura (WC) y brazo (CB), además de pliegues de la piel subescapular (DCSE) y pliegues tricpitales de la

piel (DCT). **Resultados:** el peso al nacer se correlaciona positiva y significativamente con las variables antropométricas de algunos niños, tales como: circunferencia de la cintura (WC; $p = 0.02$), circunferencia del brazo (CB $p = 0.03$), pliegue cutáneo subescapular (DCSE; $p = 0.02$) e Porcentaje de grasa corporal (% BF; $p = 0.05$). También hubo una correlación positiva estadísticamente significativa entre el peso actual del niño y el peso actual de la madre ($p = 0.04$). Además, se observó una correlación baja, pero significativa e inversa entre la altura de la madre y las variables relacionadas con la composición corporal de los niños. **Conclusión:** el presente estudio sugiere que el peso al nacer se correlaciona con la composición corporal actual de los niños, y que, independientemente del peso al nacer, el peso materno se correlaciona con el peso actual del niño, lo que demuestra la importancia de la monitorización continua del estado nutricional entre el binomio madre-hijo.

Palabras clave: Antropometría; Nutrición de la madre; Desarrollo infantil.

1. Introduction

Among early health indicators, one of the most important is the born weight (BW). If inadequate, this parameter defines concern towards public health, due to its association with morbidity and mortality increase within the first year of life and higher risk of developing illnesses during adult life. Excess weight and lower born weight values are associated with higher risks of developing systemic arterial hypertension, obesity, dyslipidemia, and also diabetes and obesity, in case of macrosomia (Araújo et al., 2006; Pereira-Freire et al., 2015; Kelishadi & Heidari-Beni, 2019).

A child's nutritional status plays a fundamental role in a progressive growth and helps the them to develop social and psychomotor abilities. Nutritional variations that provoke deficits or surplus expose those children to potential health risks, as well as future interpersonal and functional relations issues (Lynch et al., 2018; Bull & Willumsen, 2019). Excess weight in children represents a significant public and global health burden, and is a predictor of adult obesity (Kelishadi & Heidari-Beni, 2019).

There is controversial evidence on the associations between anthropometric measures with clustering of cardiovascular disease risk factors in pediatric ages. However, anthropometrical measurements are widely used to evaluate infant's health and nutritional risk, taking into account the relationship between nutrition and body dimensions during growth and developing process, from intrauterine life until adult age. Anthropometrical indexes provide nutritional risk and quality of life indicators in a practical and low cost way

(Pereira-Freire et al., 2015; Meghan et al., 2020). Growth and nutritional status evaluation sets up as an important health indicator within individual and collective levels (Li et al., 2020).

Studies show a crucial role of mother's nutritional status - such as gestational weight gain - on fetal growth and born weight. Although, studies that aim to identify the relation between current children's and mother's nutritional status are incipient. By understanding the importance of such investigations, a goal was set to inquire possible correlations of born weight from the investigated children (secondary data) with mother's body mass index (BMI), as well as evaluate the relation of BW with children's current body composition, ranging from 7 to 9 years old.

2. Methods

This is a descriptive study with a retrospective, transversal method and quantitative approach (Pereira et al., 2018). It was carried out in 41 students from public city schools, both genders, ages 7 to 9. All children whose responsible were their biological mothers, who had their born weight information, and agreed to participate took part in the study. Therefore, the studied sample was determined by convenience, capable of detecting correlation coefficients of "0.25 or higher" with test power of 80%, and an alpha of 0.05. It is also capable of detecting prevalence up to 30% with absolute precision of 8 percentage points and reliability interval equal to 95%.

Data collection took place during the period from march to october of 2010. It consisted of collecting demographic socio-economic variables (age, gender, household income, marital status – of mother and children) and anthropometrical (weight, height, waist circumference – of mother and children). To evaluate children's body composition, measurements were made of arm circumference, subscapular skinfold (SS) and triceps skinfold (TS). Born weight information was collected by an interview and form filling by the mothers.

Therefore, the following maternal anthropometrical parameters were investigated: weight, height, and waist circumference. Weight was obtained by using a digital scale with capacity up to 150kg (330.6 pounds), brand Tanita®; height and waist circumference (WC) was obtained by using an inelastic metrical tape 150cm (59 inches) long. To the maternal nutritional status, the parameters of World Health Organization (WHO) were used to classify waist circumference (WC) and Body Mass Index (BMI) (WHO, 2007; WHO, 2000).

The following anthropometrical variables of students were taken: born and current weight, height, waist circumference (WC), arm circumference (AC), subscapular skinfold (SS), and triceps skinfold (TS). An adipometer branded Cescorf® with 0,1mm precision was used to do posterior calculations of body fat percentage.

Children's waist circumference was measured following Mccarthy, Jarrett, and Crawley's (2001) recommendation. To calculate body fat percentage, the children were evaluated by skinfold thickness sum according to Slaughter, Lohman, And Boileau's (2004) protocol. Every other maternal and children's anthropometrical measurements were taken following Ministry of Health's (2007) orientations. Children's nutritional status were evaluated by Height/Age, and BMI/Age, under WHO's classification (2007).

Statistical analyses were made using the software Stata (version 9.0). The variables were presented in central tendency and dispersion; normality test, and pearson correlation to analyze the correlation existence between continuous variables. The test Shapiro Wilk was used to verify data normality. Significance of 5% was used.

The research was conducted within standards required by Helsinki declaration and approved by Research Ethical Committee of Federal University of Piau , Technical Report N  935.474, Feb 12th, 2015, abiding by ethical requirements foreseen on Resolution N  466/12 of the National Health Council that regulates and standardizes researches involving humans beings (NHC, 1996).

3. Results

The characteristics socio demographic and anthropometrical of the children included in this study ($n=41$) are presented in Table 1. The variables are described with values expressed in mean \pm standard deviation, minimum and maximum, as well as Confidence intervale 95% (CI 95%).

Table 1. Socio demographic and anthropometrical variables of the observed children.

Variables	Mean (SD)	Minimum	Maximum	CI 95%
Age (months)	92.20 (6.14)	84	108	90.25-94.13
Household Income (R\$)	603.79 (297.96)	100	1678	509.73-697.83
Birth weight (grams)	3.304 (0.48)	2.200	4.300	3.150-3.457
Current weight (Kg)	27 (4.52)	18	39	25.6-28.4
Height (cm)	125.20 (6.32)	112	142	123.20-127.20
WC (cm)	55.94 (3.79)	48	66	54.79-57.18
AC (cm)	18.58 (1.69)	15	23	18.05-19.12
TS (mm)	7.20 (1.66)	4.8	12.7	6.68-7.73
SS (mm)	6.51 (1.86)	4	12	5.93-7.10
%BF	13.30 (3.00)	9.4	21	12.35-14.24

Source: Author himself

* Values expressed in: Mean (standard deviation – SD), minimum, maximum and Confidence interval 95% (CI 95%)

WC: Waist Circumference; AC: Arm Circumference; TS: Triceps Skinfold; SS: Subscapular Skinfold; BF: Body Fat.

It is highlighted that 41 students participated in the study; 53.66% (n=22) males, the age was approximately 92 months. The average income of the researched group is low and the average birth weight was 3,304 g \pm 0.48. In addition, it is worth noting that the mean current weight (Kg) was 27 Kg \pm 4.52; mean and standard deviation the waist circumference was 55.94 \pm 3.79, as well as Body Fat percent 13.3% (Table 1).

Table 2 shows the classification of the nutritional status of the children evaluated in this research, according to Body Mass Index/age (BMI/I) and height/age (H/I), under WHO classification (2007). BMI remains useful for monitoring excess weight, however its limitations as a marker of chronic disease risk are increasingly recognized. Therefore, recent studies recognized that BMI and waist circumference are not accurate measures of body fat, especially in children.

Table 2. Children based on nutritional status.

Variables	Male		Female		Total	
	N	%	N	%	N	%
BMI/Age						
Underweight	1	4.5	1	4.5	2	4.9
Eutrophic	12	54.6	7	36.8	19	46.3
Overweight	6	27.3	9	47.4	15	36.6
Obesity	3	13.6	2	10.5	5	12.2
H/A						
Adequate height	22	100	19	100	41	100

Source: author himself

BMI/Age: Body Mass Index/Age

H/A: Height/Age

According to child's BMI, there were more overweight and obese children (48.8%) than underweight children (4.9%). However, all students (n = 41) presented same adequate linear growth; therefore, there are no indications of chronic malnourishment (Height/Age) (Table 2).

Concerning the maternal characterization regarding nutritional status and cardio metabolic complication risks, the Table 3 shows the classification conform BMI and WC in percent.

Table 3. Maternal characterization regarding nutritional status and cardiometabolic complication risks.

Classification	N	%
BMI*		
Eutrophy	21	51.22
Overweight	14	34.15
Obesity class I	03	7.32
Obesity class II	02	4.38
Obesity class III	01	2.43
WC**		
Normal	23	56.10
High Risk	08	19.51
Very High Risk	10	24.39

Source: author himself

*BMI= Body Mass Index; **WC= Waist Circumference.

When analyzing maternal nutritional status, it was verified that 34.15% and 14.63% of mothers presented overweight and obesity, respectively. Regarding central body fat distribution, 19.51% and 24.39% presented high and very high risks for cardiometabolic complications, respectively (Table 3).

The study of the correlation between weight and birth and the current anthropometric variables of children, including BMI, waist circumference and body fat are presented in Table 4. The correlation between birth weight and children's current anthropometrical variables analysed, WC, AC, triceps skinfold and body fat showed a weak correlation with birth weight.

Table 4. The study of correlation between birth weight and children's current anthropometrical variables.

Current Anthropometrical Variables	Birth Weight	
	Correlation coefficient (r)	p value
Current weight	0.14	0.37
BMI/Age	0.15	0.35
WC	0.36	0.02*
AC	0.34	0.03*
SS	0.35	0.02*
TS	0.14	0.38
BF	0.31	0.04*

Source: author himself

* Pearson's linear correlation test significance = $p < 0.05$.

BMI: Body Mass Index; WC: waist Circumference; AC: Arm Circumference

SS: Subscapular Skinfold; TS: Triceps Skinfold; BF: Body Fat

The study of correlation between birth weight and children's current anthropometrical variables showed that birth weight relates positively with WC ($r = 0.36$; $p = 0.02$) AC ($r = 0.34$; $p = 0.03$), SS ($r = 0.35$; $p = 0.02$), and %BF ($r = 0.31$; $p = 0.04$). Other parameters analyzed showed no statistically significant differences (Table 4).

The study of correlation between mother's anthropometrical variables and children's current anthropometrical measurements are presented in Table 5. The correlation between mother's anthropometrical variables and children's current anthropometrical are variables analysed, Weigh infant current showed a weak correlation with mother's weight ($r = 0.32$; $p < 0.05$).

Table 5. Study of correlation between mother's anthropometrical variables and children's current anthropometrical measurements.

Child's variables	Mother's variables.			
	Weight	Height	BMI	HC
Weight	0.32*	0.29	0.21	0.13
WC	0.19	-0.03	0.16	-0.06
AC	0.10	-0.07	0.10	-0.10
SS	0.01	-0.40*	-0.02	-0.12
TS	0.07	-0.19	0.06	0.10
BF	0.03	-0.34*	0.02	0.05

Source: author himself

* Pearson's linear correlation test significant = $p < 0.05$. Values expressed in correlation coefficient (r).

BW: Birth Weight; BMI: Body Mass Index; WC: waist Circumference; AC: Arm Circumference; SS: Subscapular Skinfold; TS: Triceps Skinfold; BF: Body Fat.

On the other hand, current maternal weight presented positive relation with children's current weight ($r = 0.32$; $p < 0.05$); it was also observed an inverse correlation between maternal height and variables that indicate the composition of children's subscapular skinfold fat (SS) ($r = -0.40$; $p < 0.05$), and total body fat (%BF) ($r = -0.34$; $p < 0.05$) (Table 5). There were significant main effects for maternal obesity and children's current anthropometrical variables.

4. Discussion

Child's nutritional status is decisive to a progressive growth and the development of social and psychomotor skills. Nutritional shortage or excess expose those children to potential risks of health harm such as born underweight, which is considered a death risk within first year of life (Brasil, 2011).

The prevalence of overweightness within student's population was 48.8%, considered high and similar to that found in other studies made in Brazil (Ramos; Dumith; César, 2014), demonstrating that the evaluated group follows the tendency of nutritional transition identified within the last few years in the country. In contrast with the overweightness observed in the mentioned study, 4.9% of children were presented underweight, proportion like the one found in the reference population of WHO's standard, indicating population's low exposure to malnourishment, at least in its acute form (Harder, 2005).

Waist circumference is considered an excellent evaluation indicator of abdominal fat tissue and an important parameter for general body composition (Santos & Leão, 2008). Still, due to the fact that until the time this paper has been written, there are no international standardization of specific cut spots for abdominal adiposity classification in the pediatric group, its function as a strong tool in public health's recommendations has been limited (Schincaglia, 2015).

This study found the average born weight among the evaluated students to be adequate according to WHO's reference standards (WHO, 2000). Besides, born weight presented significant and positive correlation with child's current HC, AC, SS, TS, and % of Body Fat. Similar results were reported by Guilherme et al. (2015) that found born weight to be responsible for a small variation in sub skin fat distribution during school age. In a study made by Pereira et al. (2010) in children aging from 5 to 8 years old in the city of Jundiaí, São Paulo, it was observed that born weight was positively associated with Body Mass Index (BMI), waist circumference (HC), and arm muscular area (AMA) (Meghan et al., 2020).

Other researchers verify that newborns with low weight presented more fat storage and suggested that these body composition differences could be a connection between fetal growth disturb and chronic adulthood diseases associated with fat storage (Committee on Nutrition, 2003). Recently, a study demonstrated that increased birth weight and maternal BMI are significant risk factors for obesity in children living in Istanbul, Turkey (Vehapoglu et al., 2017).

In this current study the correlation between born and current weight in students wasn't verified. According to a research made by Ferreira & Luciano (2010), high born weight is a predictive factor to obesity, while some other authors related this high BW to more prevalence of insulin resistance, while arterial hypertension was associated with low born weight (Pereira-Freire, 2015; Pereira, 2010). Faster prenatal and postnatal growth was associated with a higher BMI in childhood in a population with a recent history of rapid economic growth and relatively low birth weight, suggesting that maximum growth may increase cardiometabolic risk. However, there may be an association between birth weight, development of metabolic risk and other variables, such as maternal nutritional status (Li et al., 2020).

It is important to mention that adequate born weight was referred as a protector against future obesity, although for Araújo et al. (2006) there is no association, confirming what was found in this paper. However, it is relevant to emphasize that average born weight of evaluated children was adequate. Besides, for this current study this BW variable was referred

by children's parents, with due conference in the child's booklet, which could be considered a limitation to the study, due to the impossibility and difficulty of performing study of cohort in the semi-arid region of Piauí. Considering that a cohort study, despite expensive, would make it possible for a higher control of variables such as BW. Therefore, the non-conclusion about BW's real influence on the current anthropometrical parameters could be related to the differentiated lineation of scientific researches.

Faced with academic inconsistencies over the influences of BW to current weight, an investigation to other possible variables, such as maternal's, should be done, as this current study proposes. When investigating correlation of maternal data to the children's, it was observed that mother height correlated negatively to SS and %BF of their children, showing that the lower the mother height, the higher the child's total body fat will be. This is an important result that should be more explored and broaden the field of study in Brazil's northeast about it, as these data are pioneers in the region.

Amorim et al. (2010) observed 8 years old children and related an important contribution to height, mother's BMI, and socio-economic conditions in the variation of these nutritional indicators. More studies should be done to broaden the comprehension of these results. Silveira et al. (2010) statistically proved that, no matter the mother's nutritional status, low height is directly related to child's malnourishment.

It was still observed that there is a positive and significant correlation between child's current weight and mother's weight. Pereira-Freire et al. (2015) pointed out that mothers with children with overweightness presented elevated BMI, when compared to those mothers with children with lower weight. Studies showed evidences that mothers with overweightness have higher probabilities to have offspring, also, with overweight (WHO, 2007; Ramos; Dumith; César, 2014).

For some decades there has been documented that if one of the parents is overweight, the chance of the children develop it too is of 40%, but, if both parents are obese that chance goes up to 80%. It is proved in the academic that genetic information as well as socio economic and environmental conditions provided by the parents have a repercussion on the nutritional status of their offspring (Amorim et al., 2010). It is noted, consequently, that the information found in our research contributed to a better understanding and to evidence that parent's overweight interferes negatively to their children's nutritional status.

To better analyze current children's body composition, the correlation between their current anthropometrical variables were investigated. It is noted that WC presented strong correlation to skinfold (SS and TS), and with total body fat percentage. Researches detected

strong association of BMI to WC in children and teenagers, from both genders (Slaughter; Lohman; Boileau, 2004; Rodrigues, 2006). The information found showed similar results to those found on other national and international researches (WHO, 2000; Freire; Luciano, 2010).

Medina et al. (2014) noted in their studies that the competent teams related few actions about anthropometrical evaluations in school age. In that way, it is necessary to perform more investigations in the area, mainly for the reason to WC be utilized and adopted as an evaluation parameter to body composition in that age gap, due to its easiness and measurement practicality.

5. Conclusion

This paper shows that birth weight correlates with children's current body composition, and that, no matter the birth weight, mother weight correlates with children's current weight. These results suggest there is direct relation between children's and mother's current nutritional status, probably due to the fact that it is during that phase the child is fed, in which is mostly done by the mother, which results in the food habits by the mothers in the children.

Therefore, nutritional supervision of nutritional status in the mother-child relation, not only under the aspect of protein-energetic malnourishment and during pregnancy but regarding overweigh during all phases of life, will allow to offer aids to support decision making in public politics, as well as evaluate efficiency of performed actions, with focus on improving health status and nourishment of the Brazilian population.

Based on the notions of birth weight in this research, it is suggested that future studies explore the relationship between the socio-anthropometric factors of the mother-child binomial and the onset of underlying diseases in schoolchildren and the conditioning factors for situational intervention.

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