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Prevalence of factors related to the bone mass formation of children from a cohort in Southern Brazil

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Abstract

Introduction: **The amount of bone mass acquired in the early stages of life is an important determinant of its peak and future risk of osteoporosis and fractures.**

Objective: **To describe the prevalence of factors that contributes to the formation of bone mass in children of a Southern Brazil cohort.**

Methods: **A retrospective cohort study with hospital screening of all births (2741) occurred from September/2002 to May/2003 and monitoring of a random sample of 30.0% of these (one, three and six months and eight years old). During the eight years old visit, a questionnaire containing questions related to food and physical activity was applied.**

Results e Discussion: **Of the 616 children studied, 51.3% were male, 70.3% Caucasian, about half belonged to economic class C, 20.5% were overweight, 16.9% were obese and 71.2% were sedentary. As for food intake low consumption of fruits, vegetables, dairy products, meat, cereals and tubers was noticed. Vitamin D administration in the first six months of life was followed by 14.1% of premature, 16.1% of infants with low birth weight, 24.2% of weaned in the first month and only 16.4% at three months.**

Conclusion: **The evaluated children have low nutrients consumption, including calcium, inappropriate vitamin D administration in the first semester of life, little regular physical activity and high prevalence of overweight and obesity are factors that can impair the formation of bone mass.**

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PREVALENCIA DE LOS FACTORES RELACIONADOS CON LA FORMACIÓN DE LA MASA ÓSEA DE LOS NIÑOS EN UNA COHORTE EN EL SUR DE BRASIL

Resumen

Introducción: **La cantidad de masa ósea adquirida en las primeras etapas de la vida es un importante factor determinante de su pico y el riesgo futuro de osteoporosis y fracturas.**

Objetivo: **Describir la prevalencia de factores que contribuye a la formación de la masa ósea en niños de una cohorte del sur de Brasil.**

Métodos: **Estudio de cohorte retrospectiva con el hospital de todos los nacimientos (2741) se produjo en septiembre / 2002 a mayo / 2003 y el seguimiento de una muestra aleatoria de un 30,0% de los mismos (uno, tres y seis meses y ocho años de edad). En una visita a los ocho años de edad, aplicó un cuestionario con preguntas relacionadas con la alimentación y la actividad física.**

Resultados y Discusión: **De los 616 niños, el 51,3% eran hombres, el 70,3% de raza caucásica, cerca de la mitad pertenecían a la clase económica C, 20,5% tenían sobrepeso, el 16,9% eran obesos y 71,2% sedentarios. La ingesta de alimentos es bajo consumo de frutas, verduras, productos lácteos, carne, los cereales y los tubérculos. La administración de vitamina D en los primeros seis meses de vida fue seguido por 14,1% de los prematuros, el 16,1% de los recién nacidos con bajo peso al nacer, el 24,2% de destete en el primer mes y sólo el 16,4% a los tres meses.**

Conclusión: **Los niños evaluados tienen un bajo consumo de nutrientes, entre ellos el calcio, deficiente administración de vitamina D en el primer semestre de vida, poco actividad física regular y la alta prevalencia del sobrepeso y la obesidad son factores que pueden afectar a la formación de masa ósea.**

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Palabras clave: *Masa ósea. Infancia. Actividad física.*

Abbreviations

BM: Bone mass.
HIV: Human immunodeficiency virus.
RR: Relative risk.
ICU: Intensive care unit.
BMI: Body mass index.
PTH: Parathyroid hormone.
WHO: World Healht Organization.
PAQ-C: Physical Activity Questionaire for Older Children.
UCPEL: Catholic University of Pelotas.
ABEP: Brazilian Association of Research Companies.

Introduction

In recent years there has been increasing interest in determining which factors influence bone mineralization in children, since the amount of bone mass (BM) acquired in the early stages of life is an important determinant of its peak and future risk of osteoporosis and fractures[1]. So it is essential that children intensify their BM before and during periods of growth to ensure full development of their genetic potential[1].

Osteoporosis is a systemic skeletal disease characterized by low bone mass and deterioration of bone tissue micro architecture, with consequent increase in bone fragility and susceptibility to fracture[2]. According to International Foundation of osteoporosis study, the number of hip fracture cases in Brazil, currently 121,700 a year, will increase 32.0% by 2050[3]. Osteopenia and osteoporosis do not represent an exclusive concern for elders and adults, once the bone mineral density of these age groups depends on the BM peak acquired by the end of the second decade of life[4].

The BM peak can be defined as the maximum amount of bone mass that an individual accumulates from birth until skeletal maturity, therefore a key mark in skeletal health throughout life[5]. Thus, childhood and adolescence are the highest increase period on bone mineral capital[1]. Approximately 80.0% of the BM peak is determined by genetic factors and the rest is influenced by environmental factors, such as exercise, smoking, medications and nutrition[2].

Physical activity during different stages of life has been suggested as osteoporosis protection factor and represents an essential element in building and maintaining BM[6]. Studies point out that more physically active people are those with the highest BM[5-6].

A nutritionally adequate feed corresponded to a major modifiable factor in the development/maintenance of bone mass and preventing osteoporosis[7]. Thus, throughout childhood adequate calcium, phosphorus, vitamin A, D and K and protein intake is required, since these lead to reduced bone remodeling, increased calcium retention and fracture risk reduction[7].

As for factors related to birth, we can point out the gestational time and birth weight. Preterm infants are at increased risk of lower growth and bone mineralization compared to children born at term[8]. Bone development of preterm infants is complex and the restriction of intrauterine and postnatal growth may lead to repercussions in adulthood[8]. Just as premature, those born with low weight must be supplemented with iron and vitamins A and D to ensure their genetic growth potential[9].

The identification of factors that contribute for children bone mass formation represents an important strategy for preventing the occurrence of future bone disease[8]. Regarding nutritional status, the studies differ because obese and less active children have lower BM[10]. It is unclear whether this reduction in BM in obese children is a direct effect of fat on the bone or due to decreased muscle mass or reduced levels of activity or a combination of both[10]. In contrast, other studies claim that obesity acts as a protective factor against risk of fractures and osteoporosis, given that obese individuals have a higher BM in other eutrophic[10].

Taking into consideration that the influence of interactions between nutritional factors, environment, lifestyle and heredity supports the development of osteoporosis and consequent fractures[7], the assessment of BM formation predictors' prevalence in children and adolescents is important not only for the development of intervention programs, but also to play an important factor in prevention of bone diseases in adulthood[8]. Therefore, this article aims to describe the prevalence of factors that contribute to the BM formation, such as birth weight, gestational age, early weaning, childhood feed intake, physical activity and nutritional status of children in a cohort of Southern Brazil.

Methods

This is a retrospective cohort study, which had two components: perinatal (hospital screening) and monitoring (home visits with one, three and six months and eight years old). During the study period, there were 3449 births, and 81.0% (2799) of infants residing in the urban area of Pelotas. Among them, 29 were born outside the hospital, but were included in the study because they were sent there soon after birth. Ten children had early hospital discharge and were not subsequently located. We excluded 26 mothers for being human immunodeficiency virus (HIV) positive, since the main objective of the cohort study was to study aspects related to breastfeeding and 22 refused to participate. Therefore, in hospital screening the final population interviewed was 2741 mothers, representing 98.0% of all births in the target population. From this sample, 30.0% (973) were selected at random, by means of statistical program for home care in the first, third and sixth month and eight years of life.

The sample was calculated aiming for analyzes based on a 95.0% confidence level and 80.0% statistical

power for data, ranging from 15 to 80.0% and estimating a relative risk (RR) of 2.0 and 15.0% increase to the initial calculation for losses and control of confounding factors. In first month monitoring 951 questionnaires were completed, 940 in the third month, 931 in the sixth month, with 2.3%, 3.4% and 4.4% losses, respectively. In eight years old monitoring, 616 children were visited (63.0% of the initial sample). There were five refusals, 17 deaths, 93 children moved to other states or cities and 242 did not have their new addresses located.

Those with hospitalization of 24 hours or higher after birth either in nursery or intensive care unit (ICU) were not included in the study. Were eligible for inclusion in the study, all newborns from mothers living in the urban area of Pelotas and not presenting serious problems that contraindicated breastfeeding. For monitoring at eight years old, all children who were visited at six months and lived in the city of Pelotas were included in the cohort.

Data on the methodology of the cohort and accompaniments in the 1st semester of life are published[11]. For the eight years old visit, we used a standardized questionnaire which was applied to the mothers or caregivers with questions about health and eating habits.

The variables studied were: gestational age at birth, birth weight, body mass index (BMI) at eight years old, physical activity, socioeconomic factors (family income, maternal education and economic class according to Brazilian Association of Research Companies, ABEP), breastfeeding duration, and vitamin D administration in the first three months of age and food intake at eight years old.

To evaluate the eating habits we used as basis the "Food Guide- Ten Steps to Healthy Eating", created by the Ministry of Health[12]. Simple and easy to answer questions were designed for parents or legal guardians.

For the anthropometric measurements at age of eight, the child was weighed and measured with portable and precision equipment. The weight was measured with scale Tanita brand, model UM-080 Body Fat Monitor/Scale and the height with wooden stadiometer. Overweight and obesity were classified according to the curves of the World Health Organization (WHO) from 2007[13]. From them, we calculated the BMI as a diagnostic criterion for overweight and obesity, being considered overweight children with BMI-for-age ≥ score z+1 and < score z+2 and for obesity ≥ score z+2.

In the evaluation of physical activity, we used the instrument Physical Activity Questionnaire for Older Children (PAQ-C)[14], on which the classification is given according to physical activity scores from 1 (very sedentary) to 5 (very active). Anthropometric data (weight, height and waist circumference) were analyzed by gender and age on the assessment day.

Quality control was conducted through questionnaires and pre-tested instruments and questions repetition in a synthesized questionnaires in a random sample of 10.0% of all children. The questionnaires were entered into a database built through the program Epi Info 6.0 d®. We calculated the variables of interest's frequency after a bivariate analysis between the independent variables and the outcome, using the chi-square test. After the analysis, only the variables with p< 0,05 were considered to be linked to the outcome as statistically significant.

Table I
Studied sample's characteristics, Pelotas, Rio Grande do Sul, Brazil, 2011. (n=616)

Variable	*N*	*%*
Child sex		
Male	316	51,3
Femamle	300	48,7
Child color		
Caucasian	433	70,3
Not Caucasian	183	29,7
Family income[a]		
≤ 1	85	13,8
1,01-3	308	50,0
3,01-6	144	23,4
>6	66	10,7
Ignored	13	2,1
Economic Class		
A1 e A2	24	3,9
B1 e B2	202	32,8
C1 e C2	325	52,8
D e E	65	10,5
Maternal education level		
Illiterate / 3rd graders	34	5,5
4th graders	176	28,6
Elementary education	133	21,6
High school education	213	34,6
University graduated	53	8,6
Ignored[b]	7	1,1
Gestational age at birth		
< 37 weeks	66	10,7
>37 weeks	550	89,3
Birth weight		
< 2500g	49	8,0
≥2500g	567	92,0
Breastfeeding until six months		
Yes	324	52,6
No	292	47,4
BMI classification		
Low weight	11	1,8
Adequate weight	375	60,8
Overweight	126	20,5
Obesity	104	16,9
Level of physical activity		
Very sedentary	103	16,7%
Sedentary	336	54,5%
Moderately active	160	26,0%
Active	17	2,8%
Total	616	100,0

[a]In minimum wages. [b]Children who do not live with the mother.

The research project was approved by the Ethics Committee of Catholic University of Pelotas (UCPEL) with mothers or legal guardians having signed a new Terms of Informed Consent, since the age of eight visit was not contemplated in the original cohort design. On this visit, a printed copy of "Food Guide for the Brazillian population"[12] had been delivered to the mothers and children who were identified as having health problems were referred for care.

Results

On follow-up to age of eight, 616 children were interviewed, being 51.3% boys; 70.3% Caucasian; 92.0% were born weighing more than 2500 g and 10.7% with gestational age of less than 37 weeks. As for maternal education, 34.6% had completed high school (Table I).

The anthropometric nutritional assessment identified 20.5% of overweight children, occurring in 19.6% of boys and 21.7% of girls. While obesity was observed in 16.9% of the sample with 19.9% of boys and 14.0% of girls. Therefore, the prevalence of overweight in the sample was 37.4%. As for physical activity, less than 30% of children were considered active (Table I).

Table II shows food consumption according to the frequency of adherence to the Ten Steps to Healthy Eating. As to the factors associated with BM, children avoided the salt increase in food but had low intake of foods rich in calcium, fiber, vitamins and phosphorus. When comparing food intake with socioeconomic factors, it can be seen that the lower the economic class, a greater beans consumption, good source of phosphorus, and a higher sweets, soft drinks and goodies consumption, while with a higher maternal education level, a lesser bean consumption, and a higher fats, sweets and treats consumption. (Table III).

Regarding the use of vitamin D according to the gestational period, birth weight and early weaning, its administration in the first three months of life was followed by 14.1% of premature, 16.1% of low birth weight infants, 24.2% of weaned in the first month and 16.4% of weaned at three months (data not shown in table).

Discussion

A bone health is directly dependent on the intake of certain nutrients, including calcium, which with regular consumption in childhood and adolescence would increase the BM peak and reduce the risk of osteoporosis in later decades[15]. In addition, adequate levels of calcium intake can maximize the positive effects of physical activity on bone health during the period of growth in children[16]. In this study, only 25.0% of children followed the daily recommendation of three servings of dairy products[12], a similar result to studies with schoolchildren[18].

Research shows high protein intake from schoolchildren, contrary to the results of this study, which showed that only 32.8% of children consume the recommended

Table II
Studied children's food intake, Pelotas, Rio Grande do Sul, Brazil, 2011. (n=616)

Food consumption	*n*	*%*
At least three meals and two light lunches a day	463	75,2
Daily consumption of six grain group portions	241	39,1
Daily consumption of six tubers and roots group portions	41	6,7
Whole grain consumption	17	2,8
Daily consumption of at least three vegetable portions	43	7,0
Daily consumption of at least three fruit portions	56	9,1
Daily consumption of beans	449	72,9
Daily consumption of three milk and dairy products portion	154	25,0
Daily consumption of one meat, fish, chicken or eggs portion	202	32,8
Maximum daily intake of a vegetable oils, olive oil or butter or margarine portion	352	57,1
Avoid soft drink consumption	475	77,1
Avoid processed juices consumption	385	62,5
Maximum daily intake of sweet biscuits, stuffed and other goodies portion	493	80,0
Not adding salt to ready meals	521	84,6
Consumption of at least two liters of water per day	55	8,9

Table III
Food consumption according to socioeconomic factors of the studied sample. Pelotas, Rio Grande do Sul, Brazil, 2011. (n=616)

Variable	*Daily consumption of six tubers and roots group portions and Whole grain consumption (%)*	*Daily consumption of three vegetable and three fruit portions (%)*	*Daily consumption of beans (%)*	*Daily consumption of three milk and dairy products portion and maximum consumption of 1 meats and/or egg portion (%)*	*Maximum consumption of 1 fat portion (%)*	*Avoid soft drinks/ juices and candies consumption (%)*	*Sodium addition in ready meals (%)*
Economic Class							
(ABEP)[a] p value*	0.24	0.97	0.03	0.98	0.10	0.000	0.30
A	75.00	0.00	58.33	4.17	62.50	70.83	83.33
B	76.73	2.97	73.76	5.94	64.36	50.50	87.13
C	76.00	1.54	78.77	6.46	51.38	37.23	83.69
D e E	66.15	3.08	80.00	4.62	61.54	40.00	81.54
Maternal education level							
pvalue**	0.22	0.51	0.000	0.82	0.02	0.000	0.95
Illiterate/ 3rd graders	88.24	5.88	82.35	2.94	50.00	20.59	85.29
4th graders	72.73	1.70	83.52	5.68	51.70	37.50	82.95
Elementary education	70.68	2.26	78.20	9.02	57.89	36.09	86.47
High school education	76.53	1.88	70.89	5.16	60.56	49.30	85.45
University graduated	79.25	1.89	64.15	3.77	66.04	71.70	81.13

[a]Ranked by the Brazilian Association of Research Companies. A economy class comprises people with higher purchasing power and E economic class those with less purchasing power. *Chi-square test for linear trend. **Chi-square test for heterogeneity.

daily portion[19-20]. A study performed with elderly men and women, higher protein intake in the diet was associated with a lower rate of age-related bone loss[21].

Fruits and vegetables intake is very important for children, as well as the positively contribution to growth and development, it can assist in body weight maintenance and chronic diseases [22]. In children evaluated in this study the low vegetables (7.0%) and fruits (9.1%) intake is impressive. A similar result to a study conducted by Conceição et al. 2010, with 570 schoolchildren aged 9 to 16 years of public and private school systems in Brazil, who found low fruits and vegetables consumption[24]. These results raise concerns, as these foods are good sources of potassium that can positively influence bone health markers, thus contributing to osteoporosis reduction[23].

Phosphorus is another essential nutrient and acts as a regulator of bone formation and resorption inhibitor, however, there is an agreement that high amounts could be detrimental to the bone, since they produce transient drop in plasma calcium resulting in increased parathyroid hormone (PTH) secretion and potentially bone resorption[25]. Cereals as well as the legumes represent good sources of serum phosphorus and in studied children there were low consumption of cereals (39.1%), tubers and roots (6.7%) and a good amount of legume consumption (72.9%).

A favorable aspect on the food intake, 77.1% of children avoided the consumption of soft drinks, which acts as a positive aspect; because cola based beverages contain caffeine and phosphoric acid, which can adversely affect bone health through generation of acid load in the body[7]. Another positive aspect was that the majority of children (84.6%) did not add salt to ready meals, which is positive since the dietary sodium chloride represents potential damage to the BM as its increased ingestion, elevates urinary calcium excretion[26]. It is noteworthy that the information on consumption of soft drinks and salt may not reflect the actual habit of children, but a false positive due to omission.

The increase in chronic diseases new cases in recent decades is due in part to lifestyle habits acquired over a lifetime[27]. Physical activity is important as preventive and curative factor, and when practiced regularly and early, prevents the loss of BM and consequently osteoporosis. This practice should occur from childhood because it is the stage of life in which the maximum bone mass is reached. Alarming was the fact that 71.2% of children in this study had one and two scores in the PAQ-C[14], related to physical activity, demonstrating that the vast majority is sedentary or less active.

The anthropometric nutritional assessment identified 20.5% of overweight and obesity was observed in 16.9% of the sample. Therefore, the prevalence of overweight in the sample was 37.4%. On the influence of body weight and other compartments of body composition on the BM, there is controversy about what is the meaning of the association between excessive body weight and BM[28].

Vitamin D administration in the first six months of life was followed by 14.1% of premature, 16.1% of low birth weight infants, 24.2% of weaned in the first month and 16.4% of weaned at three months. Alarming results since early weaned babies born with low birth weight or premature infants need vitamin D supplementation, so that the development/normal maintenance of skeletal structures occur through improved quality and/or bone strength[7]. The recommendation of 200 IU of vitamin D up to 18 months is required for breastfeeding infants who do not have regular sun exposure and for infants who do not receive 500 ml per day of infant formula, and for babies born with low birth weight and premature[29]. Importantly, in addition to the impact on bone metabolism, the level of vitamin D may influence the further development of some chronic diseases such as type 1 diabetes, hypertension and cancer[30].

This study had as limitations the fact of being a retrospective study, in which the information were only analyzed during the cohort visits, a food frequency questionnaire was not applied to verify the consumption of foods rich in bone formation related nutrients and also the sun exposure has not been evaluated.

Of the studied children, low consumption of dairy products, fruits and vegetables, cereals, legumes, low exercise frequency, high overweight prevalence and inadequacies of vitamin D administration in the first months of life was perceived. Knowing that the BM peak is reached in late adolescence and early adulthood, it is necessary to optimize modifiable factors that can affect bone mass, including vitamin D administration. Thus, it is evident the importance of early intervention during the first years of life, promoting better quality of life in childhood to prevent the emergence of many diseases, including bone diseases.

References

1. Silveira PP, Portella AK, Goldani MZ, Barbieri MA. Developmental origins of health and disease DOHaD. *J Pediatr* (Rio J). 2007; 83(6): 494-504.
2. Peters BSE, Martini LA. Nutritional aspects of the prevention and treatment of osteoporosis. *Arq Bras Endocrinol Metab* 2010; 54/2.
3. International Osteosporosis Fundation [Internet]. A systematic review of hip fracture incidence and probability of fracture worldwide [citado em 2014 ag 5]. Disponível em: http://www.iofbonehealth.org/
4. Sarita Lucila Betancourt Ortiz. Densidad mineral ósea, calcio dietético y factores presuntivos de riesgo de osteoporosis en mujeres ecuatorianas de la tercera edad. *Nutr Hosp* 2014 Aug 1; 30(2):372-84.
5. María Correa Rodríguez, Blanca Rueda Medina, Emilio González Jiménez, Carmen Flores Navarro Pérez, Jacqueline Schmidt-RioValle. Los niveles de mineralización ósea están influenciados por la composición corporal en niños y adolescents. *Nutr Hosp* 2014; 30(4):763-768.
6. Kohri T, Kaba N, Murakami T, Narukawa T, Yamamoto S, Sakai T, et al. Search for promotion factors of ultrasound bone measurement in japonese males and pré/post menarcheal females aged 8-14 years. *J Nutr Sci Vitaminol* 2012; 58: 263-271.

7. Ramírez-Prada D, de la Torre MJ, Llórente-Cantarero FJ, Pérez-Navero JL, Gil-Campos M. Evaluation of solar exposure, intake and physical activity in relation with vitamin D serum status in Spanish prepubertal girls. *Nutr Hosp* 2012 Nov-Dec; 27(6):1993-8.
8. Wauben IP, Atkinson SA, Grad TL, Shah JK, Paes B. Moderate nutrient supplementation of mother´s milk for preterm infants supports adequate bone mass and short-term growth: a randomized, controlled trial. *Am J Clin Nutr* 1998; 67:465-72.
9. Mayer GN, Cancelier ACL, Franciotti DL. Comparação do crescimento de bebês com baixo peso ao nascer com bebês nascidos com peso adequado: estudo de coorte. *Arquivos Catarinenses de Medicina* 2011; vol. 40, nº 4.
10. Borges JLC, Brandão CMA. Low Bone Mass in Children and Adolescents. *Arq Bras Endocrinol Metabvol* 2006; vol.50 nº 4.
11. Mascarenhas ML, Albernaz EP, Silva MB, Silveira RB. Prevalência de aleitamento materno exclusivo nos 3 primeiros meses de vida e seus determinantes no Sul do Brasil. *J Pediatr* (Rio J.) 2006; vol.82 nº.4.
12. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Coordenação Geral da Política de Alimentação e Nutrição. Guia alimentar para a população brasileira: promovendo a alimentação saudável. Brasília, DF, 2006. 210 p.
13. World Health Organization. The WHO child growth standards 2007. [cited 2014 Ag 16]. Disponível em: http://www.who.int/childgrowth/en.
14. Kowalski KC, Crocker PRE, Honours RMDB. The Physical Activity Questionnaire for older children (PAQ-C) and adolescents (PAQ-A) Manual. College of Kinesiology, University of Saskatchewan, 87 Campus Drive. Saskatoon, SK, Canadá. August 2005; S7N 5B2.
15. Flynn A. The role of dietary calcium in bone health. *Proc Nutr Soc* 2003; 62(4): 851-8.
16. Specker B and Binkley T. Randomized trial of physical activity and calcium supplementation on bone mineral content in 3- to 5-year-old children. *J Bone Miner Res* 2003; 18:885.
17. Albano RD, Souza SB. Ingestão de energia e nutrientes por adolescentes de uma escola pública. *J Pediatr* (Rio J). 2001; 77(6): 512-16.
18. Albuquerque MFM, Monteiro AM. Ingestão de alimentos e adequação de nutrientes no final da infância. *Rev Nutr* 2002; 15(3): 291-99.
19. Moreira P, Santos S, Padrão P, Cordeiro T, Bessa M, Valente H, et al. Food patterns according to sociodemographics, physical activity, sleeping and obesity in Portuguese children. *Int J Environ Res Public Health* 2010; 7:1121-38.
20. Wardle J, Sanderson S, Leigh Gibson E, Rapoport L. Factor-analytic structure of food preferences in four-year-old children in the UK. *Appetite* 2001; 37:217-23.
21. Tucker KL, Chen H, Hannan MT, Cupples LA, Wilson PWF, Felson D, et al. Effect of dietary protein on bone loss in elderly men and women: the Framingham Osteoporosis Study. *J Bone Miner Res* 2002; 15:2504.
22. Miller P, Moore RH, Kral TV. Children's daily fruit and vegetable intake: associations with maternal intake and child weight status. *J Nutr Educ Behav* 2011; 43: 396-400.
23. Conceição SIO, Santos CJN, Silva AAM, Silva JS, Oliveira TC. Consumo alimentar de escolares das redes pública e privada de ensino em São Luís, Maranhão. *Rev Nutr Campinas* 2010; 23(6): 993-1004, nov/dez.
24. Rafferty K, Davies KM, Heaney RP. Potassium intake and the calcium economy. *J Am Coll Nutr* 2005; 24(2):99-106.
25. Koshihara M, Masuyama R, Uehara M, Suzuki K. Effect of dietary calcium: Phosphorus ratio on bone mineralization and intestinal calcium absorption in ovariectomized rats. *Biofactors* 2004; 22(1-4):39-42.
26. Carbone LD, Barrow KD, Bush AJ, Boatright MD, Michelson JA, Pitts KA, et al. Effects of a low sodium diet on bone metabolism. *J Bone Miner Metab* 2005; 23(6): 506-13.
27. Barreto SM, Pinheiro ARO, Sichieri R, Monteiro CA, Batista Filho M, Schimidt MI, et al. Análise da Estratégia Global para Alimentação, Atividade Física e Saúde, da Organização Mundial de Saúde. *Epidemiologia e Serviços de Saúde* 2005; 14(1): 41-68.
28. Correa Rodríguez M, Rueda Medina B, González Jiménez E, Navarro Pérez CF, Scmidt- RioValle J. The levels of bone mineralization are influenced by body composition in children and adolescents. *Nutr. Hosp* 2014 Oct 1; 30(4): 763-8.
29. Sociedade Brasileira de Pediatria. Departamento de Nutrologia. Manual de orientação: para alimentação do lactente, do pré-escolar, do escolar, do adolescente e na escola. São Paulo. 2006. 64p.
30. Martínez Suárez V, Moreno Villares JM, Dalmau Serra J, Comité de Nutrición de la Asociación Española de Pediatría.Recommended intake of calcium and vitamin D: positioning of the Nutrition Committee of the AEP. *An Pediatr* 2012; 77: 57.