DOI: 10.1590/1413-81232018248.23642017

Milk types and their contribution to daily sodium and calcium intake

Alex Oliveira da Camara (http://orcid.org/0000-0002-9832-7014) [1]
Orlando Marino Gadas de Moraes (http://orcid.org/0000-0001-5880-7921) [2]
Lucia Rodrigues (http://orcid.org/0000-0003-3475-281X) [3]

Abstract *Low calcium consumption and high sodium intake among adolescents is a serious public health problem. Thehigh content and bioavailability of calcium in milk makes it the best choice for meeting the Dietary Reference Intakes (DRIs) for calcium. Since milk also contributes to sodium intake, programs promoting milk consumption should be preceded by initiatives to reduce its sodium content. Knowing the calcium and sodium content of processed milk is essential for establishing the adequate consumption of milk. The aim of this study was to estimate the calcium and sodium content of different brands of powdered and ultra heat treated (UHT) milk sold in supermarkets in Rio de Janeiro and calculate the amount of these milks that should be consumed by adolescents to meet daily calcium needs and the impact of this consumption on sodium intake. Volumetric analysis was used to measure calcium content and sodium content was determined using flame photometry. The mean calcium and sodium concentrations of powdered (mg/26g) and UHT milk (mg/200ml) were 262.5 ± 5.1 mg and 116.8 ± 3.1 mg and 246.0 ± 10.3 mg and 162.5 ± 16.3 mg, respectively. Milk intake sufficient to meet the DRI for calcium among adolescents would result in a sodium intake of 584 mg (39% of the AI) from the consumption of powdered milk and 812.5 mg (54% of the AI) from the consumption of UHT milk.*

Key words *Milk, Calcium, Sodium, Adolescents*

[1] Instituto Nacional de Câncer José Alencar Gomes da Silva (INCA). R. Equador 831, Santo Cristo. 20220-410 Rio de Janeiro RJ Brasil. alex.nutrj@gmail.com
[2] Departamento de Ciências dos Alimentos, Universidade Federal do Estado do Rio de Janeiro (Unirio). Rio de Janeiro RJ Brasil.
[3] Departamento de Nutrição em Saúde Pública, Unirio. Rio de Janeiro RJ Brasil.

Introduction

Data from *Pesquisa de Orçamentos Familiares* (POF, 2008-2009)[1] showed that average daily intake of foods containing calcium was very low: whole milk, 38.6 ml; sweetened milk drinks, 43.5ml; yogurt, 13.8ml; cheese, 3.8g, and kale, 2.2g. Average daily calcium intake among adolescents living in urban areas ranged between 529 and 581mg, depending on age and sex, which is below the recommended level[1].

Given that calcium is an essential nutrient required for multiple biological functions, inadequate calcium intake during adolescence can give rise to health problems such as obesity, hypertension, and osteoporosis[2-5]. There was a six-fold increase in the prevalence of overweight among adolescent boys and an almost three-fold increase in girls between 1974 and 2008(from 3.7% to 21.7% and 7.6% to 19.4%, respectively). A similar trend, though less pronounced, was also witnessed in relation to obesity[6]. Individuals with low calcium intake may be more susceptible to the accumulation of body fat in adipocytes– probably due to a mechanism involving the expression of the *agouti* gene in these cells– and to elevated serum parathyroid hormone(PTH) and 1,25-dihydroxyvitamin D_3levels, promoting the influx of calcium into the cells and stimulating lipogenesis and thus reducing lipolysis[7].

Moreover, population-based studies have demonstrated that blood pressure in adolescents is strongly influenced by overweight/obesity[8,9] and that calcium has a blood pressure lowering effect. Studies have suggested that calcium contributes to the stability of smooth muscle membranes[10], natriures is, sodium homeostasis[11], phosphate depletion, and increased prostacyclin synthesis[12].

Osteoporosis is a serious public health concern with a large economic impact andconstitutes a significant financial burden on the health system. Although there is no consensus about the age at which peak bone mass occurs, various authors regard adolescence as a critical period for bone mass gain because bone formation occurs at a greater rate than bone resorption in both sexes due to increased bone mineralization rates[14-18]. The consumption of foods containing calcium during adolescence is therefore essential to the primary prevention of osteoporosis[13].

In addition to a low calcium intake, POF identified a high sodium intake in the general population (4,700 mg/day), equivalent to approximately 12g of salt. Daily sodium intake was above the tolerable upper intake level (2,300mg/day) in over 70% of adolescents, with girls and boys with 10-13 years old consuming 3,158 and 2,930mgdaily, respectively. Sodium intake was even higher among boys (3,744 mg) and similar in girls (2,915 mg)in the 14 to 18 year age group[1].

Low calcium consumption associated with high sodium intake among adolescents leads to increase drenal calcium excretion, which can cause serious health problems. It is calculated that 30 to 40mg of calcium is lost in the urine for every 2g rise in dietary sodium intake[4]. Moreover, high sodium consumption is associated with the development of chronic noncommunicable diseases (CNCDs)[2-4].

The knowledge of the concentrations of calcium and sodium present in industrialized milks, whose additives are based on sodium, is fundamental to establish adequate quantities of this food for the population, aiming to meet the Dietary Reference Intakes (DRI)[19,20] of these nutrients.

Current food composition tables and industrialized food labels do not always state nonmandatory calcium content and it is not clear whether the sodium content has been analyzed or calculated based on these tables[21]. The aim of this study was therefore to estimate the calcium and sodium content of different brands of powdered and Ultra High Temperature (UHT) pasteurized milk sold by leading supermarket chains in Rio de Janeiro and calculate the amount of these milks that should be consumed by adolescents to meet calcium intake recommendations and the impact of this consumption on sodium intake.

Methods

Three brands of powdered milk (A, B, and C) and five brands of UHT milk (D, E, F, G, and H) were selected from 10 stores belonging to three leading supermarket chains located in the north and south zones of Rio de Janeiro. These brands were selected because they were available in all ten stores. The sample of UHT milk brands was larger because the supermarkets offered a greater variety of UHT milk products.

A fully randomized statistical design was adopted, and eight different lots of the selected brands for both types of milk were randomly collected in different neighborhoods of the two zones of the municipality of Rio de Janeiro. For each batch, the calcium and sodium concentrations were obtained by the average of three determinations performed in parallel.

First, the samples were homogenized. The UHT milks were shaken in the carton pack, while the powdered milks were homogenized into a piece of kraft paper and quartered. These processes were repeated until a 10g sample was obtained, which was stored in hermetically sealed glass containers.

Calcium concentration was determined using method 396/IV developed by the Adolfo Lutz Institute[22]. To determine sodium concentration, adequate masses of the samples previously-determined based on the content stated on the food label were weighed in pre-weighed porcelain capsules using a Shimadzu® analytical balance AUY120 and then converted to ash, as recommended by the Association of Official Analytical Chemists[23]. Sodium content was determined by flame photometry using AOAC Method 990.23[24] and a PG Instruments Limited digital flame photometer FP910. The solutions used to create the calibration curve were prepared using a sodium standard solution1000 mg L^{-1} (Sodium Standard for AAS Fluka). The analyses were performed in the Bromatology and Chemistry Laboratory at the Federal University of State of Rio de Janeiro's School of Nutrition.

For the application of inferential statistics (ANOVA[25] and Welch Test[26]) between the means of calcium and sodium contents obtained through the analysis of different milk brands, the Bartlett's test[27] was first performed to verify if the variances calculated from the mean calcium and sodium contents obtained for the different lots were homocedastic or heterocedastic, and thus determine the t test to be applied in each case. The statistical analyses were performed using Microsoft Office Excel 2007 and ACTION System programs. The results obtained were always compared with the critical parameters at a significance level of 5%.

Based on the calcium and sodium contents quantified in powdered milk and UHT milk, an estimate was made of the volume of milk that should be consumed in order to reach the level of dietary calcium intake capable of satisfying the daily needs of practically all healthy adolescents (97.5%), i.e. 1300 mg. From this volume, the contribution of sodium from industrialized milk to AI (Adequate Intakes) of this nutrient was assessed. The estimate was made based on AI, since the studies so far developed did not allow the establishment of RDA (Recommended Dietary Allowances) and EAR (Estimated Average Requirement) for sodium, being considered 1,500 mg the value of daily dietary intake that seems to reduce the risk of chronic non-communicable diseases[19,20].

Results

The coefficients of variation for each brand showed that there was no relevant variation in calcium concentration between the different analysed batches of both the powdered and UHT milk brands (Table 1). The results were expressed in mg for 26g of powdered milk and 200 ml of UHT milk, as these are the quantities presented in the nutrition labelling of these products. In the case of milk powder, the portion indicated on the labelling is that needed to prepare 200 mL of milk. The mean calcium concentration of powdered and UHT milk was 262.5 ± 5.1mg and 246.0 ± 10.3 mg, respectively.

With regard to sodium concentrations, the mean value measured for UHT milk (162.5 ± 16.3mg) was higher than for powdered milk (116.8 ± 3.1mg) (Table 2).

The Bartlett's test[27] showed that the assumption of homocedastic variances was valid for the mean calcium values of the powdered and UHT milk batches and for the mean sodium values of the powdered milk batches. These means were therefore compared using the ANOVA[25]. The assumption of homocedastic variances was shown to be invalid however for the mean sodium values of the UHT milk batches. These means were therefore compared using Welch's t-test[26] which indicated that the means were not statistically identical.

The ANOVA results indicated that there was no statistically significant difference between the mean calcium and sodium concentrations determined for the different batches of powdered milks. However, in relation to the mean calcium concentrations of UHT milks, the test indicated that the difference between them was statistically significant.

The mean calcium and sodium concentrations determined by the analysis of the different brands of powdered milk and UHT milk were compared with the values declared on the labels, in order to verify the difference (%) between them (Table 3). It was found that the mean calcium concentrations of milks F and H and mean sodium concentrations of milks A, C, D, and F were over 20% higher (the legally permitted threshold) than the content stated on the labels[20].

The calculation of estimated milk intake to achieve calcium RDA (1,300mg)[20] for adolescents

Table 1. Mean calcium concentration and standard deviation (SD) and coefficient of variation (CV) of the different batches of powdered (mg/26g) and UHT (mg/200ml) milk.

Batches	Powdered Milk Brands			UHT Milk Brands				
	A	B	C	D	E	F	G	H
1	255.2	256.8	251.5	272.7	259.6	281.8	245.1	249.7
2	262.4	266.5	257.1	276.3	263.5	263.6	218.8	225.3
3	258.6	262.9	266.1	248.1	258.8	246.3	255.5	222.6
4	250.4	261.7	255.9	269.3	233.4	251.5	228.0	227.5
5	277.5	267.1	267.3	262.2	234.4	256.4	234.6	240.3
6	274.7	257.4	259.7	242.1	233.5	233.1	228.8	247.9
7	290.2	256.5	268.7	236.3	236.6	256.1	247.6	243.1
8	278.1	247.9	248.5	246.2	248.9	256.5	243.1	245.6
Meana (mg)	268.4	259.6	259.4	256.6	246.1	255.7	233.9	237.7
SD (mg)	13.7	6.3	7.5	15.3	13.1	13.9	10.4	10.9
CV (%)	5.1	2.4	2.9	5.9	5.3	5.5	4.4	4.6

[a] Mean calculated using the means for each batch.

Table 2. Mean sodium concentration andstandard deviation (SD) andcoefficient of variation (CV) of the different batches of powdered (mg/26g) and UHT (mg/200ml) milk.

Batches	Powdered Milk Brands			UHT Milk Brands				
	A	B	C	D	E	F	G	H
1	121.2	122.3	115.7	176.7	165.6	181.1	152.9	159.1
2	111.6	121.5	125.5	171.1	140.2	178.1	150.3	125.4
3	128.8	129.9	118.2	220.6	142.8	195.4	150.3	161.9
4	124.9	109.4	120.7	190.1	167.6	196.4	135.8	137.6
5	109.3	130.9	106.7	163.2	162.9	147.1	141.6	157.9
6	109.4	114.3	104.8	170.5	138.1	163.5	140.2	174.7
7	116.7	115.2	113.5	179.5	155.7	158.4	154.4	135.6
8	112.2	115.4	105.3	214.7	159.1	163.3	153.2	167.4
Meanb(mg)	116.8	119.9	113.8	185.8	154.0	172.9	147.3	152.4
SD (mg)	7.4	7.7	7.6	21.2	11.9	17.8	7.1	17.4
CV (%)	6.4	6.4	6.7	11.4	7.7	10.3	4.8	11.4

[b] Mean calculated using the means for each batch.

aged 10 to 18 years indicates a consumption of 5 glasses of milk per day (1,000 mL per day). This would result in a sodium intake of 584 mg (39% of AI) for milk powder consumption and 812.5 mg (54% of AI) for UHT milk consumption.

Discussion

Some population-based studies have shown a downward trend in the consumption of calcium and an increase in sodium intake among adolescents, which can have harmful health impacts[1,28]. The Study of Cardiovascular Risk Factors in Adolescents (ERICA, acronym in Portuguese) shows that inadequate consumption of calcium and vitamins A and E among adolescents has worsened in the five years since the POF 2008-2009. The inadequate consumption of these nutrients is associated with elevated consumption of sodium, saturated fat, and sugar and may be related to increased consumption of ultra-processed foods[28].

Current pattern of calcium and sodium intake by adolescents may have serious consequences and, if this situation is not changed, may cause future damage to the health status of these young people and also generate negative impacts on the country's economy (increase in health

Table 3. Percentage difference between the means of calcium and sodium concentrations determined by analysis and those declared on the labels of powdered milk (mg/26g) and UHT milk (mg/200mL).

Brands	Calcium 1* (mg)	Calcium 2** (mg)	Difference (%)	Sodium 1* (mg)	Sodium 2** (mg)	Difference (%)
Powdered milk						
A[a]	268.4	246.0	9.1	116.8	95.0	22.9
B[a]	259.6	233.0	11.4	119.9	100.0	19.9
C[a]	259.4	239.0	8.5	113.8	91.0	25.1
UHT milk						
D[b]	256.6	240.0	6.9	185.8	143.0	29.9
E[b]	246.1	248.0	- 0.5	154.0	130.0	18.5
F[b]	255.7	210.0	21.8	172.9	129.0	34.0
G[b]	233.9	210.0	11.4	147.3	130.0	13.3
H[b]	237.7	183.0	26.5	152.4	168.0	- 9.3

[a]Powdered milk (26g portion) [b]UHT milk(200 ml portion) *1 – analyzed **2 – label

spending: higher number of hospitalizations and increased expenditure on the purchase and distribution of medicines and health aid). Encouraging milk consumption may be a possible solution to increase calcium intake and minimize the situation. Milk contains significant amounts of calcium as well as vitamin D, phosphorus, protein, zinc, and magnesium, which make a significant contribution to the formation of a stable bone structure. Furthermore, the calcium in milk has high bioavailability and is readily digestible. Dark green leafy vegetables, sardines, tuna, and certain seeds are also rich in calcium, but have low acceptability among adolescents[1,28]. Health professionals should therefore encourage the consumption of these foods since childhood. Cheeses contain large amounts of sodium and fat and are very expensive. Milk drinks increase sugar intake, thus contributing to obesity, which is already a serious concern among adolescent's health. In view of the above, milk is the best option for meeting the RDA for calcium, and its consumption should therefore be encouraged. Despite its numerous benefits, milk can contribute to increased sodium intake. The findings of this study show that it would be necessary to drink five 200 ml portions of milk a day (1,000 ml/day) to meet the RDA for calcium and that the sodium intake from this consumption corresponds to 54% of the AI, depending on the type of milk consumed(powdered or UHT)[19].

The daily milk intake for adolescents recommended by the Brazilian Pediatric Society (500 ml)[29] would meet only 50% of the RDA for calcium, meaning that the remaining 50% of nutrient needs would have to be satisfied by other sources, making it very difficult to attain the RDA due to the factors mentioned above. Even if these recommendations were followed, sodium intake would be high due to the intake of sodium from powdered and UHT milk, accounting for 18% and 27% of the AI, respectively[19].

Our study showed that calcium intake through the consumption of milk powder is slightly higher (7%) and that sodium intake is significantly lower (28%) compared to UHT milk, suggesting that both adolescents and the general population should consume milk powder.

A study conducted in the United Kingdom[30] investigating food categories known to be major contributors to sodium intake in the UK diet revealed that milk was one of the five food categories that accounted for one-third of sodium purchased (37%). The study also showed that the sodium contribution of milk was due to volume rather than concentration.

Based on the findings of this study, the sodium intake from the breakfast recommended by the government's Dietary Guidelines for the Brazilian Population[31]–consisting of milk with coffee, a buttered bread roll, and fruit (for example, papaya)–would be between 568 and 650mg[32], depending on the type of milk used. This corresponds to between 37 and 43% of the AI for sodium, with milk alone contributing 10% of the recommended average daily intake, based on an average consumption of between 200 and 300ml. It is important to note that this meal is also associated with the consumption of other high-sodium processed or ultra-processed foods[31].

Substituting bread with tapioca with butter would reduce sodium intake to between approximately 288 and 370 mg[32], accounting for between 19 and 24% of the AI. However, although

this would lead to a significant reduction in sodium content, the food category that contributes most to total sodium intake is milk (58%). This demonstrates the importance of providing food and nutrition education and guidance to promote healthy eating. Substituting bread and butter with tapioca or tubers is a possible alternative for reducing sodium intake. However, the ERICA[28] reported high levels of bread consumption among adolescents, even in the north and northeast regions (64.8% and 54.5%, respectively) where eating tubers for breakfast is more culturally acceptable[28,31].

In view of the above, it is important to reflect on how to meet the calcium intake recommendations for adolescents without causing a major impact on sodium intake. One alternative would be to reduce the amount of sodium-based additives in UHT milk, such as monosodium and disodium phosphate and sodium citrate. It is important to note that sodium content analysis does not show the origin of the sodium in milk. Since 2010, the Ministry of Health began to promote discussions with organizations working directly or indirectly to reduce sodium consumption[33,34]. These discussions have yet to include milk, perhaps because it is classified as a minimally processed food or because it is not widely recognized that it can contribute to high sodium intake. However, contrary to popular belief, this study demonstrates that – largely due to the additives used in these products – the concentration of sodium in powdered and UHT milk is by no means low, considering the number of daily portions that would have to be consumed to meet the RDA for calcium. Another possibility would be to encourage industry to fortify milk with calcium so that smaller portions of milk would be required to meet the adequate intake of calcium, thus avoiding increased sodium intake. However, this option would certainly result in higher product prices.

Another option would be to encourage the consumption of powdered milk. Although a feasible alternative, people generally prefer ready-to-drink milk. According to the Brazilian Long Life Milk Industry Association, 87% of Brazilian households drink UHT milk and this type of milk accounts for 47% of the country's milk consumption[35]. Apart from being more practical than powdered milk, which needs to be reconstituted, many people prefer the taste of UHT milk[36].

In conjunction with any of above strategies, programs should be implemented to encourage the consumption of calcium-rich foods (such as milks and derivatives, dark green leafy vegetables, and fish), particularly among children and adolescents. Brazil's Healthy School Program (PSE, acronym in Portuguese)[37], created by Decree 6.286 of December 5, 2007to promote nutritional guidance for students in the public school system, could be used to raise awareness of the importance of these foods to promote healthy eating habits, which are protective factors against CNCDs.

It is important to stress that milk should not be excluded from the diet of children and adolescents, since it is an important source of calcium, which is essential for the adequate formation and maintenance of bones[14]. Furthermore, it is essential to promote education actions focusing on *Guia Alimentar para a População Brasileira*[30] on the consumption of high-sodium processed foods (preserved foods, dried meat, bacon, bread, cheese, etc) and ultra-processed food (biscuits, ice-cream, sausages and hams, instant noodles, packaged snacks, sodas, milk drinks, and ready-made meals such as pizzas, nuggets, etc.).

Another worrying finding of this study is the discrepancies between the sodium and calcium concentrations of the samples and the content stated on the food labels. Food labeling is regarded as an important public health tool because it provides health professionals and consumers basic information about food items, such as origin, composition, nutritional value, shelf life, and method of preservation. Industrialized food labels must observe Resolution - RDC Nº 360, of December 23, 2003[21], governing nutrition labeling of pre-packed foods ready for offer to the consumer. RDC Nº 360[21] allows for a margin of error of up to 20% for the stated value versus actual value of nutrients. With respect to calcium, only brands F (21.8%) and H (26.5%) were outside the permitted 20% variance. However, major differences were found between the stated and actual values of sodium, especially in powdered milks, where all brands were outside the permitted variance.

In view of the above, it is vital to raise public awareness and call on the government to regulate the dairy industry so that it provides milk of better nutritional quality to the domestic market, preferably without additives, thereby allowing consumers to enjoy the recognized benefits of a food that dates back thousands of years.

Conclusion

The analyses performed show that both powdered and UHT milk are great sources of calcium, with average levels of this mineral of 262 mg and 246 mg, respectively, per 200 ml portion. The sodium content of UHT milk(163mg) was shown to be higher than that of powdered milk (117mg). The comparison of stated calcium and sodium values versus values found in this study showed that some brands of UHT milk and all powdered milk brands were outside the permitted 20% variance, indicating the need for better government monitoring and surveillance of the food industry.

Milk is an important food for meeting calcium recommendations and its consumption is a protective factor against health problems in adult life. Children and adolescents should be encouraged to consume milk as an essential component of health eating habits in order to reduce the risk of developing chronic diseases in adulthood. To this end, the food industry should provide milk of better nutritional quality, without additives that change its original composition, and that enhances the bioavailability of calcium, a mineral of utmost importance for overall health, especially in periods of intense growth.

Collaborations

AO Camara was responsible for chemical analysis and helped draft this article. OMG Moraes defined the methodology used in the study, supervised implementation, and helped draft this article. L Rodrigues defined the study topic, provided supervision, and helped draft this article.

References

1. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa de Orçamentos Familiares 2008-2009. Análise do consumo alimentar pessoal no Brasil*. Rio de Janeiro: IBGE; 2010.
2. Miller GD, Jarvis JK, McBean LD. The Importance of Meeting Calcium Needs with Foods. J. Am. Coll. Nutr. 2001; 20(Supl. 2):168S-185S.
3. Goldberg TB, Silva CC, Peres LN, Berbel MN, Heigasi MB, Ribeiro JM, Suzuki K, Josué LM, Dalmas JC. Calcium Intake and its Relationship with Risk of Overweight and Obesity in Adolescents. *Arch Latinoam. Nutr* 2009; 59(1):14-21.
4. Heaney RP: Role of dietary sodium in osteoporosis. *J Am Coll Nutr* 2006; 25 (3 Supl.):271S-276S.

5. Ralston RA, Lee JH, Truby H, Palermo CE, Walker KG. A Systematic Review and Meta-analysis of Elevated Blood Pressure and Consumption of Dairy Foods. *J Hum Hypertens* 2012; 26(1):3-13.
6. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa de Orçamentos Familiares 2008-2009. Antropometria e estado nutricional de crianças, adolescentes e adultos no Brasil*. Rio de Janeiro: IBGE; 2010.
7. Goldberg TB, Silva CC, Peres LN, Berbel MN, Heigasi MB, Ribeiro JM, Suzuki K, Josué LM, Dalmas JC. Calcium intake and its relationship with risk of overweight and obesity in adolescents. *Arch Latinoam Nutr* 2009; 59(1):14-21.
8. Rosa MLG, Mesquita ET, Rocha ERR, Fonseca VM. Índice de massa corporal e circunferência da cintura como marcadores de hipertensão arterial em adolescentes. *Arq. Bras. Cardiol.* 2007; 88(5):573-578.
9. Souza MGB, Rivera IR, Silva MAM, Carvalho ACC. Relação da Obesidade com a Pressão Arterial Elevada em Crianças e Adolescentes. *Arq. Bras. Cardiol*. 2010; 94(6):714-719.
10. Crawford MCW, Wang MC, Sabry ZI, Hudes M, Bacharach LK. Adolescent diet is predictive of peak bone mass. *Am J Clin Nutr* 2002; 75(Supl.):356S-356S.
11. Zemel MB, Gualdoni SM, Sowers JR. Reduction in total and extracellular water associated with calcium-induced natriuresis and the antihypertensive effect of calcium in blacks. *Am J Hypertension* 1988; 1(1):70-72.
12. Lau K, Chen S, Eby B. Evidence for the role of P04 deficiency in antihypertensive action of a high Ca2+ diet. *Am J Physiol* 1984; 246(3 Pt 2):H324-H331.
13. Lopez-Jaramillo P, Guarner F, Moncada S. Effect of calcium and parathyroid hormone on prostacyclin synthesis by vascular tissue. *Life Sci* 1987; 40(10):983-986.
14. Khoury JC, Lanphear BP. Milk intake during childhood and adolescence, adult bone density, and osteoporotic fractures in US women. *Am J Clin Nut* 2003; 77(1):257-265.
15. Kalkwarf HJ, Khoury JC, Lanphear BP. Milk intake during childhood and adolescence, adult bone density, and osteoporotic fractures in US women. *Am J Clin Nut* 2003; 77(1):257-265.
16. Abrams SA, Grusak MA, Stuff J, Brien KOO. Calcium and magnesium balance in 9-14 y-old children. *Am J Clin Nutr* 1997; 66(5):1172-1177.
17. Greer FR, Krebs NF. American Academy of Pediatrics Committee on Nutrition. Optimizing bone health and calcium intakes of infants, children, and adolescents. *Pediatrics* 2006; 117(2):578-585.
18. Weaver CM. The role of nutrition on optimizing peak bone mass. *Asia Pac. Clin. Nutr*. 2008; 17(Supl. 1):135-137.
19. Institute of Medicine. *Dietary reference intakes for water, potassium, sodium, chloride, and sulfate*. Washington: National Academy Press; 2004.
20. Institute of Medicine. *Dietary reference intakes for calcium and Vitamin D*. Washington: National Academy Press; 2011.
21. Agência Nacional de Vigilância Sanitária (Anvisa). Resolução RDC nº 360, de 23 de dezembro de 2003. *Diário Oficial da União* 2003; 23 dez.
22. Zenebon O, Pascuet NS, coordenadores. Métodos físico-químicos para análise de alimentos. 4ª Edição. São Paulo: Instituto Adolfo Lutz; 2005.
23. Association of Official Analytical Chemists. *Methods of Analysis*. 16th ed. Gaitherburg: AOAC; 1997.
24. Association of Official Analytical Chemists (AOAC). *Official Methods of Analysis of AOAC International*. 17th ed. Gaithersburg: AOAC; 2000.
25. Scheffé H. *The Analysis of Variance*. New York: Willey; 1999.
26. Welch BL. The generalization of "Student's" problem when several different population variances are involved. *Biometrika* 1947, 34(1-2):28-35.
27. Bartlett MS. Properties of Sufficiency and Statistical Tests. *Proceedings of the Royal Statistical Society Series A* 1937; 160:268-282.
28. Souza AM, Barufaldi LA, Abreu GA, Giannini DT, Oliveira CL, Santos MM, Leal VS, Vasconcelos FAG. ERICA: ingestão de macro e micronutrientes em adolescentes brasileiros. *Rev Saude Publica* 2016; 50(Supl. 1):5s.
29. Sociedade Brasileira de Pediatria (SBP). Departamento de Nutrologia. *Manual de orientação para a alimentação do lactente, do pré-escolar, do escolar, do adolescente e na escola*. 3ª ed. Rio de Janeiro: SBP; 2012.
30. Mhurchu CN, Capelin C, Dunford EK, Webster JL, Neal BC, Jebb SA. Sodium content of processed foods in the United Kingdom: analysis of 44,000 foods purchased by 21,000 households. *Am J Clin Nutr* 2011; 93(3):594-600.
31. Brasil. Ministério da Saúde (MS). *Guia alimentar para a população brasileira*. Brasília: MS; 2014.
32. Núcleo de Estudos e pesquisas em Alimentação (NEPA). *Tabela brasileira de composição de alimentos*. 4ª ed. Campinas: NEPA- UNICAMP; 2011.
33. Associação Brasileira das Indústrias da Alimentação (ABIA). *Acordo de Cooperação Técnica entre o Ministério da Saúde e a ABIA (Associação Brasileira das Indústrias da Alimentação) para a redução de sal/sódio nos alimentos processados*. São Paulo: ABIA; 2010.
34. Nilson EAF, Jaime PC, Resende DO. Iniciativas desenvolvidas no Brasil para a redução do teor de sódio em alimentos processados. *Rev. Panam Salud Publica* 2012; 34(4):287-292.
35. Associação Brasileira da Indústria de Leite Longa Vida. *Leite Longa Vida está presente em 87% dos lares brasileiros*. [acessado 2016 Abr 15]. Disponível em: http://www.ablv.org.br/implistcontentint.aspx?id=528&area=imp-not
36. Campagnolo L, Bampi, GB. Análise sensorial comparativa de leite em pó e leite fluído. *Hig Aliment* 2014; 28(234/235):194-196.
37. Brasil. Ministério da Saúde (MS). *Saúde na escola*. Brasília: MS; 2009.

Article submitted 28/08/2015
Approved 18/12/2017
Final version submitted 20/12/2017