

A study on the prevalence of adequacy of Iron and Vitamin C in children's diets

Estudo de prevalência de adequação de Ferro e Vitamina C em dietas infantis

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ABSTRACT: The aim of this study was to apply methodological procedures to determine the prevalence of adequacy of Iron and vitamin C in children's diets. It was included 238 children aged 2 to 3 years enrolled in 2009 in 25 day care centers in the municipality of Rio de Janeiro. Dietary intake was assessed by weighing the food and food record. Assessing the prevalence of nutrient adequacy took into consideration the individual and the group. The best estimate of the needs of the individual is given by the estimated average requirement (EAR), since we do not know the true needs of the individual who is being evaluated. To estimate the need of the group method was used EAR as the cutoff. The prevalence of adequacy of iron and vitamin C in children's diets was 91.2 and 62.2%, respectively. All necessary to achieve the method EAR as the cutoff were used, but became unviable the adjustment of the observed consumption data to estimate the distribution of usual intake in this group. We conclude that the study of probability of adequacy of habitual diet in iron and vitamin C in the age group in question was only possible with the use of procedures for the individual.

Keywords: Anemia, Iron-Deficiency. Child, preschool. Food consumption. Iron. Ascorbic acid. Dietary reference intake. Day care center.

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RESUMO: O objetivo deste estudo foi aplicar procedimentos metodológicos para determinar a prevalência de adequação de ferro e vitamina C em dietas infantis. Foram incluídas na amostra 238 crianças de 2 e 3 anos matriculadas no ano de 2009 em 25 creches no município do Rio de Janeiro. O consumo alimentar foi avaliado por pesagem de alimentos e registro alimentar. Para avaliação da prevalência de adequação de um nutriente levou-se em consideração o indivíduo e o grupo. A melhor estimativa das necessidades do indivíduo é dada pela necessidade média estimada (EAR), já que não se conhece a necessidade verdadeira do indivíduo que se está avaliando. Para estimar a necessidade do grupo foi utilizado o método da EAR como ponto de corte. A prevalência de adequação de ferro e vitamina C nas dietas infantis para cada criança foi de 91,2 e 62,2%, respectivamente. Foram utilizadas todas as premissas necessárias à consecução do método da EAR como ponto de corte, porém tornou-se inviável o ajustamento dos dados de consumo observado para estimar a distribuição do consumo habitual neste grupo. Conclui-se que o estudo de probabilidade de adequação da dieta habitual em ferro e vitamina C no grupo etário em apreço só foi possível com a utilização dos procedimentos destinados ao indivíduo.

Palavras-chave: Anemia ferropriva. Pré-escolar. Consumo de alimentos. Ferro. Ácido ascórbico. Consumo dietético de referencia. Creche.

INTRODUCTION

The prevalence of iron deficiency anemia in preschoolers is one of the concerns in public health. A study conducted in daycare centers with children under five years of age in the city of Rio de Janeiro presented a prevalence of 47.3%¹.

The Ministry of Health² has implemented, among others, the National Program for Iron Supplementation, along with the mandatory fortification of wheat and corn flour with Iron and Folic Acid, and nutritional orientation, which constitute the set of strategies that aim at controlling and reducing iron deficiency anemia in the country. The main point of this nutritional orientation is the concern with the bioavailability of Iron from vegetables, as its absorption is favored in the presence of Vitamin C and hindered in dairy foods due to the presence of Calcium, and also in foods that are rich in phytates³. The Ministry of Health⁴ also recommends that children be breastfed at least until six months of age.

Data from the 2002 – 2003 Family Budget Survey (FBS) point to an increase in the consumption of industrialized products, which are rich in saturated fat and monosaccharides, and to a decrease in the intake of greens, fruits, legumes and cereals. Legumes, a source of Iron from vegetables, need to be ingested with Vitamin C in order to make Iron bioavailable³. However, upon observing the consumption of black beans in the FBSs, a reduction of 30% was verified between the periods of 1974 – 1975 and 2002 – 2003^{5,6}.

Evaluating food consumption among children is a fundamental tool to plan initiatives of health promotion and prevention of iron deficiency anemia in groups at risk.

A document of the Institute of Medicine⁷ presents two methods to apply the DRI (Dietary Reference Intake) in dietary assessments, with calculations of the probability of adequacy/inadequacy for groups in Appendix E, and also for individuals. However, there is a more marked scarcity of works produced with the purpose of showing the distribution curves of these nutrients with gross and adjusted data, thus indicating the probability of adequacy/inadequacy in population groups. The purpose of this study was to determine the prevalence of adequate ingestion of Iron and Vitamin C in the diets of preschoolers by considering both methods described above.

METHODOLOGY

This study is part of a project linked to the line of research Nutrition and Life Quality, conducted at Universidade do Estado do Rio de Janeiro. It was approved by the Ethics Committee of Pedro Ernesto University Hospital (794-CEP/HUPE), and it complies with Resolution 196/96 of the National Health Council⁸. The participants were children whose legal guardians signed the informed consent form.

This is a cross-sectional study carried out in 2009. We included in the sample 238 children from 2 to 3 years of age, enrolled for the same school period in 25 full-time daycare centers — 21 private and 4 public — in the city of Rio de Janeiro. The inclusion criterion was the absence of chronic diseases that could interfere with their nutritional status. The initial proposal was to include all the children enrolled in the daycare centers. However, this was not possible due to the refusal of some legal guardians to keep a food journal that would complement the dietary survey. For this reason, the participants composed a pilot sample for which we calculated precision by considering the average of Iron and Vitamin C intake⁹. Figure 1 displays our methodological procedures.

During phase 1, the food consumption of the preschoolers while at the daycare centers was obtained by means of directly weighing their food on three nonconsecutive days and analyzing the nutritional composition of the meals.

In order to quantify the foods and preparations consumed at the daycare centers, the solids were weighed with a digital scale that had a maximum capacity of 2 kg, graduation of 1 g, tare function, and automatic actuation. The liquids were measured with the aid of graded containers and registered on a specific form before being offered to the children. The foods that had their quantity or volume stated on their labels/packages were not weighed.

In case the child asked for a second serving, the same portion given in the first serving was provided, and the same procedure described above was followed.

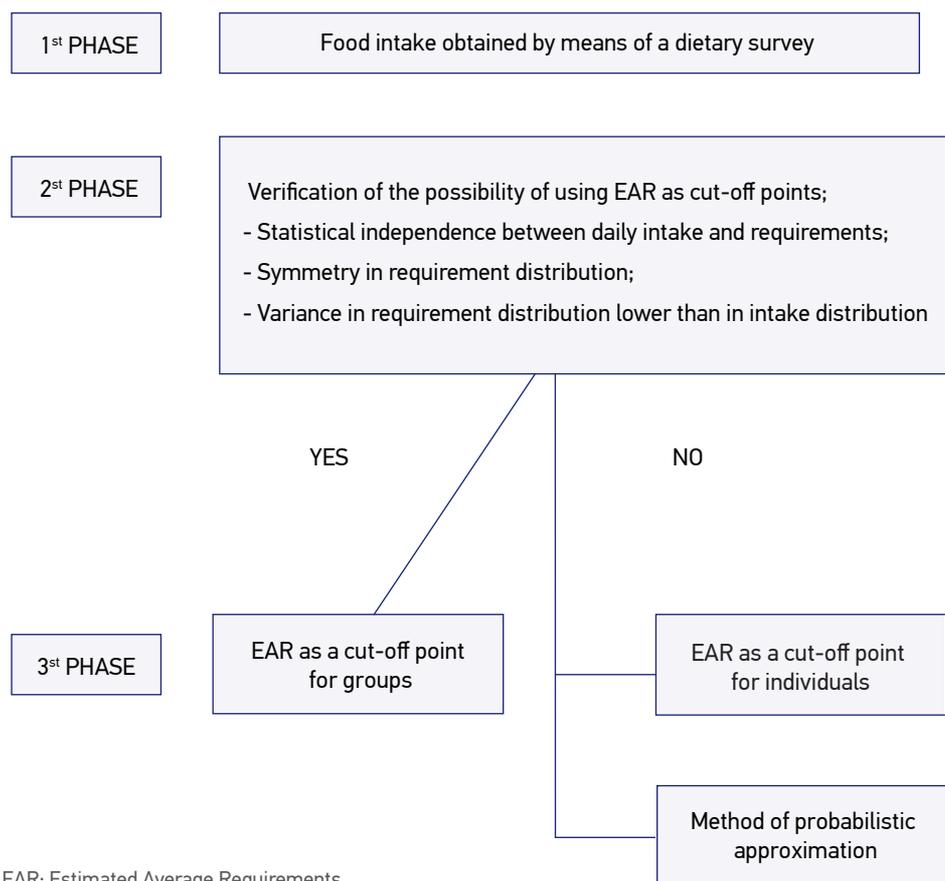


Figure 1. Architecture of the methodological procedures.

When there were leftovers at the end of each meal, we weighed what was left on the plate or cup of each child. To obtain the amount of each component of the meals offered, we considered the weight of the leftovers in proportion to the weight of the foods initially portioned and included in the meal. In case the children selected which components were part of the meal offered, the leftovers were calculated by the difference between the total weight of the meal and the foods selected. Next, we calculated the percentage of each component's participation in the mix. The individual food ingestion of each preparation was obtained through the formula:

$$\text{Individual food ingestion} = \text{portion offered} - \text{leftovers}$$

With the purpose of complementing the assessment of the children's daily ingestion, their legal guardians kept a food journal. They were oriented to write down the foods and

beverages ingested by the children before and after daycare. These foods were described in household measurements and later converted into grams and milliliters. The parents or legal guardians were contacted whenever we had doubts about the foods recorded.

A quantitative evaluation of the nutritional composition of the children's diets was conducted with the aid of the program Diet Pro version 4.0¹⁰, information displayed on labels, and the Brazilian Food Composition Table¹¹.

Phase 2 comprised the verification of the possibility of using the procedures listed on the *Estimated Average Requirements* (EAR) as a cut-off point of adequacy of Iron and Vitamin C in the group of children, according to the presuppositions displayed on Figure 1. In case all the presuppositions were confirmed, the EAR method would be used as a cut-off point for the groups. Otherwise, we would opt for the "EAR as the cut-off point for individuals".

With the purpose of verifying whether the nutrients' consumption and requirements were independent statistically, we opted for the graphic method proposed by Bland & Altman¹². This method is based on the premise that there is no obvious relation between the differences of values obtained from two matrices yielded by the application of different procedures. Under these circumstances, a lack of concordance can be identified by calculating potential biases estimated through the average of the differences and their respective standard deviation. The authors argue that what is sought is a concordance between the matrices, and not an association. According to this proposal, the difference between the matrices' values show the distance between the latter, which represent concordance or independence¹³.

The symmetry in the distribution of requirements was verified by asymmetry coefficient percentiles¹⁴. Regarding the last premise — namely that variances in the distribution of requirements would be small in relation to consumption distribution — our point of departure was the coefficient of variation (CV) established for the age range from 1 to 8 years¹⁵ at 40% and 10% for Iron and Vitamin C, respectively. Next, we calculated the standard deviation using the EAR and the variances.

The use of the EAR method as a cut-off point for the groups followed the sequence explained below¹⁶:

- a) We verified the Gaussian behavior of the consumption distribution of the nutrients in question using Kolmogorov-Smirnov's test (K test). If normal, we carried on the procedure; if not, the variables were transformed into Napierian logarithms. The K test was again applied to the converted variables. The gross values of the variables with normal distribution were used; for those with normal distribution after the aforementioned transformation, we used logs;
- b) Estimates of intrapersonal (S^2_w) and interpersonal (S^2_b) variances, calculated through the analysis of the variance (one-way ANOVA) of consumption per individual during three days.

Ratios:

Intrapersonal variance: $S^2_w = QM_w$

Interpersonal variance: $QM_b = S^2_b = (QM_b - S^2_w) / K$

In which:

QM_w : Intrapersonal quadratic mean

S_w^2 : Intrapersonal variance

QM_b : Interpersonal quadratic mean

S_b^2 : Interpersonal variance

K: number of days of dietary survey of each individual;

- c) Calculation of the ratio between interpersonal and observed standard deviations:

$$S_b / S_{obs} = 1 / [(1 + S_w^2 / K * S_b^2)]^{1/2};$$

- d) Calculation of the mean ingestion of the nutrients, considering the K days of survey for each individual;

- e) Adjustment of the observed mean ingestion of the nutrients for each individual:

$$\text{Adjusted variable of the nutrient} = \text{mean} + (x_i - \text{mean}) * S_b / S_{obs}$$

In which:

Mean: represents the group's consumption average

X_i : the value observed for each individual.

This adjustment in the observed consumption distribution was necessary so as to remove day-to-day consumption variability (intrapersonal variability). The results estimated the habitual consumption distribution, thus better reflecting interindividual variability within the group;

- f) Reconversion of log variables into original units;
- g) Adjusted distribution of the nutrients;
- h) Calculation of the prevalence of inadequacy in the population group: proportion of individuals in the group whose habitual intake was below the EAR established for the nutrient;
- i) Calculation of the probability of inadequacy given by the area under the normal curve, which corresponds to the proportion of individuals with consumption adequacy/inadequacy¹²:

$$Z = (\text{mean} - \text{EAR}) / \text{sd}; \text{ in which sd: standard deviation.}$$

When using the EAR method as the cut-off point, our point of departure was the premise that the best estimate of an individual's necessities is given by the EAR (estimated average nutritional needs), since the true necessity of each individual assessed is unknown^{12,17}.

The needs varied among the individuals, even when they were in the same stage of life and were of the same gender. Therefore, it is important to take this variability into account, given by the nutrient's CV. For analytical purposes, in the present study we opted for using a CV of 10% for the nutrients, as suggested by the Food and Nutrition Board of the Institute of Medicine (IOM/DRI)^{16,17}.

In order to calculate the "apparent adequacy"¹⁸ of the nutrients, we used a statistical approach that enables estimates of the degree of confidence at which the intake of nutrients fulfills the individual's needs. With this approach, we compared the difference between the average of "n" days of consumption (the best estimate of habitual intake) and the EAR. The equation devised also takes into account the variability of the individuals' necessities (Vnec) and day-to-day intrapersonal variation (Vint). The result is a Z score through which the probability that a diet is adequate is determined. We considered an individual "apparent ingestion"¹⁸ adequate when the probability was higher than 0.7¹⁷.

$$Z = \frac{D}{DPp} = \frac{\text{Mean of "n" days of consumption} - \text{EAR}}{\sqrt{Vnec + Vint / n}}$$

In which:

Vnec: variability of the individuals' necessities;

Vint: interpersonal variance, obtained from North American population studies⁷;

n: number of days in which the individual's ingestion was assessed.

In the third phase, we used the method of probabilistic approximation only for Iron, since the requirements for Vitamin C distribution were unavailable. The statistical method of probabilistic approximation (risk curve) combines the requirements for distribution and the individual's ingestion in order to verify the probability of risk for iron deficiency anemia.

In the construction of the risk curve, the requirements for Iron were given by the ordinate, and the probability of risk for iron deficiency anemia by the abscissa. Iron deficiency anemia was outlined here based on the estimated percentiles of distribution of the requirements for iron (mg/d) for children, adolescents and adults, available in Appendix I, table I-3¹⁵, where the estimated percentiles are P_{2,5}; P_{5,0}; P₁₀; P₂₀; P₃₀; P₄₀; P₅₀ (EAR); P₆₀; P₇₀; P₈₀; P₉₀; P₉₅ (*Recommended Dietary Allowance* – RDA), and the intervals follow a succession in tens. The last two percentiles are allocated at 95 and 97.5. Each percentage point is followed by the required amount of Iron in milligrams. The risk expressed on the abscissa created in the present study corresponds to each percentile cut-off point divided by 100, as the probability of occurrence had to be described between 0.00 and 1.00.

RESULTS

The profile of the dietary consumption of the nutrients in question during the three days of observation is presented on Table 1.

The mean amount of Iron and Vitamin C consumed during the three days of observation was 6.25 mg and 18.52 mg, respectively. The relative error of the estimates of mean Iron consumption reached 4.37% (CV = 34.43%); for Vitamin C, it reached 8.64% (CV = 67.99%). These findings denote a high variability for both nutrients, more expressively for Vitamin C.

It was only possible to verify the presupposition about the independence between consumption and requirements in the case of Iron^{15,19}, as there were no available data regarding Vitamin C. For this purpose, we used the children’s mean Iron intake.

As displayed on Figure 2 — Bland and Altman’s dispersion diagram¹² — we verified that all differences rested below -1, with an expressive distance from 0, thus indicating dependence between consumption and daily requirements.

Upon verification of the symmetry of Iron requirements, the percentile coefficient of asymmetry¹⁴ reached 0.22, which indicates that its distribution is approximately symmetrical.

The variance of the distribution of Iron requirements (1.44 mg) was small in relation to the distribution of consumption (4.20 mg). The only presupposition that was rigorously met pertained to the variance of the distributions.

Table 1. Profile of food intake of the children at the daycare centers during three non-consecutive days.

Nutrients	Statistics	Minimum – Maximum	Median	Mean (SD)	Variance	Coefficient of variance	95%CI
Iron	Intake 1	0.70 – 13.63	6.86	6.23 (2.15)	4.64	34.56	0.27
	Intake 2	0.60 – 16.61	7.10	6.20 (2.28)	5.19	36.72	0.29
	Intake 3	0.80 – 15.95	6.95	6.30 (2.20)	4.86	35.00	0.28
	Mean of the 3 days	0.70 – 15.39	6.73	6.25 (2.15)	4.62	34.43	0.27
Vitamin C	Intake 1	3.80 – 78.31	15.04	17.33 (9.88)	97.71	57.03	1.26
	Intake 2	2.80 – 128.09	15.12	18.46 (15.18)	230.34	82.22	1.93
	Intake 3	3.10 – 155.17	14.96	19.76 (17.38)	302.05	87.96	2.21
	Mean of the 3 days	3.23 – 106.36	15.00	18.52 (12.59)	158.51	67.99	1.60

SD: standard deviation

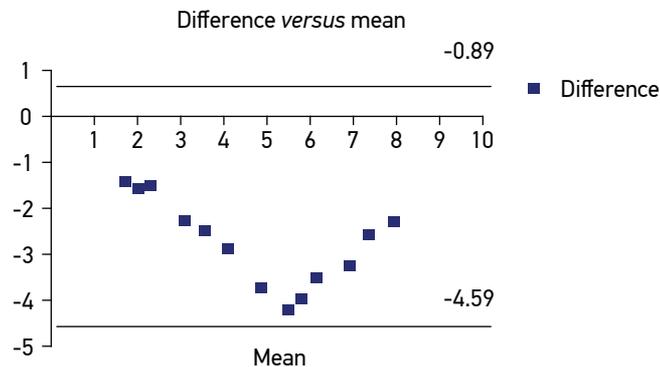


Figure 2. Difference versus mean, considering Iron consumption and requirements.

We initiated the procedure of applying the EAR as a cut-off point for groups by verifying the Gaussian behavior of the distribution of Iron intake (Table 2). The results show that the intake distribution during the three days of observation did not meet the requirements of the method, even though we attempted to convert the distributions into logarithms.

In light of this, we proceeded to establish adequacy individually. Considering a cut-off point higher than 0.70 as the probability of adequacy¹⁷, we found that 70.0% and 7.9% of the children had adequate intakes of Iron and Vitamin C, respectively.

Table 2. Statistical procedures inherent to the method.

Normality Test						
Iron						
I1		I2		I3		Decision
KS Distance	p-value	KS Distance	p-value	KS Distance	p-value	
Gross values						
0.1657*	< 0.0001	0.1664*	< 0.0001	0.1633*	< 0.0001	no
Logarithmized values						
0.1827*	< 0.0001	0.2040*	< 0.0001	0.1889*	< 0.0001	no

*significant; KS: Kolmogorov-Smirnov.

Table 3. Prevalence of adequacy and inadequacy of Iron and Vitamin C in the children's diets (n = 238).

Probability of adequacy	Discrimination	Nutrients %	
		Vitamin C	Iron
<i>Recommended Dietary Allowances</i> (p ≥ 0.98)	Adequate	0.4	2.5
<i>Estimated Average Requirements</i> (p = 0.50 to p < 0.98)		61.8	88.7
<i>Estimated Average Requirements</i> (p < 0.50)	Inadequate	37.8	8.8

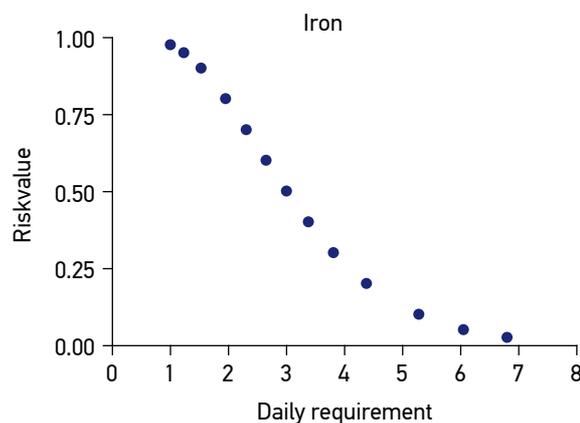


Figure 3. Risk curve for Iron.

Table 3 presents the prevalence of adequacy and inadequacy according to the EAR and the RDA. Considering the latter, the prevalence of adequacy was expressively low both for Vitamin C and Iron.

Figure 3 displays the risk curve for Iron. To verify this probability of risk, the intake was placed on the ordinate that expresses requirements, and a perpendicular line was traced until it touched the curve. At this point, a line was traced in parallel to the ordinate. The point that touches the abscissa indicates the probability of risk.

Drawing on the graphic (Figure 3), it was possible to estimate the risk for Iron consumption by tracing up a perpendicular line that started at the abscissa until it touched the curve and a parallel line was drawn from this intersection point to the ordinate. For instance, a child in the group studied who presented a mean Iron consumption of 2.73 mg in three days of observation had a probability of inadequacy of 0.625.

DISCUSSION

In the present study, the mean Iron and Vitamin C intake in the three days of observation was 6.25 mg (CV = 34.43) and 18.52 mg (67.66), respectively. In an interventional study carried out with data from a large transversal survey in the city of São Paulo between September 1995 and September 1996, the authors found an Iron intake of 7.7 mg in the control group and of 7.6 mg in the intervention group before the intervention, as recorded on food journals, both with CV = 5%²⁰. Comparing these findings, it is possible to verify a high variability in Vitamin C consumption¹⁷. In another study, of a longitudinal nature, in which the participants were 35 children between 2 and 3 years of age of both sexes, enrolled in a philanthropic daycare center in Ilha de Paqueta, Rio de Janeiro from 2003 to 2004, the authors found an Iron intake of 5.1 ± 1.7 mg ($p < 0.001$; CV = 33%) and a Vitamin C intake of 31.5 ± 25.5 mg ($p < 0.001$; CV = 81%)²¹. These values are approximate to the ones found in the present study, and reaffirm the variability in the consumption of both nutrients.

The guidelines of the Subcommittee for DRI Interpretation and Use alert that the RDA should not be used as a cut-off point to assess nutrient intake in groups, as this level of consumption exceeds the requirements of 97 to 98% for all individuals whenever the requirements within a group have normal distribution. This recommendation aims at avoiding overestimates of the proportions in groups at risk for inadequacy¹⁹.

In this sense, it is necessary to use the methods in question, probabilistic approximations, and the EAR as cut-off points to assess the prevalence of inadequacy of nutrient intake.

Both methods demand independence between daily ingestion and requirements. In order to evaluate this premise, in the case of Iron, we used Bland & Altman's method¹², as its advantage is that the matrices of the data are exempt from Gaussian behavior, and a minimum of 10 measurements in pairs can be used²². The requirement measurements obtained through the reference percentiles for Iron totaled 13.

It is observable that all differences are within the interval ranging from -4.59 to -0.89, which is quite distant from a null difference, thus indicating independence between requirement and ingestion (Figure 1). However, using the deviation ratio proposed by Delcourt¹³, we cannot affirm this independence.

The percentile coefficient of asymmetry for Iron points to an approximately symmetrical distribution of Iron requirement (0.22), inferred from its position in relation to the EAR. The daily requirements for Iron include the necessary amounts to replace fecal and dermatologic elimination, and this aspect might have symmetrically affected Iron distribution in the population of reference. In case of lack of additional information about the requirement distribution of a given nutrient, it is implicitly assumed on DRI reports that the unknown distribution is considered symmetrical, based on median requirements – EAR. Thus, when the fact that a certain requirement distribution is asymmetrical comes to light, a probabilistic approach can be used to compute a risk curve that reflects an asymmetrical requirement. The guidelines of the Subcommittee for DRI Interpretation and Use reveal that moderate asymmetry values in requirement distribution can result in noticeable biases when estimating prevalences by means of cut-off point methods⁷.

Although presuppositions of symmetry in the requirement distribution of a given nutrient and the independence between consumption and necessity are assumed in the DRI's document⁷, we verified all presuppositions. It is worth highlighting that this premise originated from population studies with larger samples than the one presented here. In the case of Iron, the EAR is determined by a factor model based on median components of its requirement for men and women. In the case of children, gender is ignored, as the differences are small. Taking Vitamin C into account, the RDA was established with a coefficient of variation of 10%. The EAR can be estimated by dividing the RDA by 1.20¹⁸. Both were established based on the recommendations for adults, according to body weight.

In this study we also took care of verifying the Gaussian behavior of the distributions of the ingestion observed; when it was absent, we adopted logarithmic normal distribution, which was the particular case of Vitamin C. However, the normality test did not allow for considerations of the Gaussian behavior of the consumption curves, preventing us from using the method for groups which enables the displaying of the gross and adjusted distributions of a nutrient's intake.

Although daycare centers offer institutionalized meal services, the variance in Iron consumption, considering the three days of ingestion, was 4.62 mg (Table 1). The variance of distribution to determine Iron requirements is 1.44 mg. Situations in which the variance of distribution to determine Iron requirements is higher than the variance of its consumption — which is not the case in this study — are related to the monotony of the menus, since the portions served are controlled⁷. It is important to highlight that the mean Iron consumption, considering the three days of ingestion, was between the values of the EAR (4.1 mg) and of the RDA (7 mg)¹⁵, which ensures at least 50% of the nutritional recommendations for the population of interest.

With the information obtained, we constructed the risk curve for Iron. However, it was not possible to construct it for Vitamin C, in view of the lack of available research data that could be the basis for establishing the EAR for the 1 to 18-year age range. Consequently, the requirement distribution is also not available for this population. The EAR for children and adolescents was estimated by adjusting the data for adults and based on differences in reference weights⁷.

The EAR method as a cut-off point is valid when the prevalence of inadequacy in a given population is higher than 8 to 10%, or lower than 90 to 92%⁷. In this study, we verified a prevalence of inadequacy of 37.8% and 8.8% (Table 3) for Vitamin C and Iron, respectively. These findings suggest validity only in the case of Iron.

In regards to the quality of the data on dietary consumption, we must point out some obstacles, as tables that display food composition do not include Iron and Vitamin C in a large number of fortified industrialized foods, wheat flour, and cornmeal²³. This problem is aggravated by the non-regulated addition of these nutrients to food products, especially those directed to children. Possible interferences with the calculations of the adequacy of Iron and Vitamin C are due to overestimates of consumption.

Information on the food ingestion that occurred at the daycare centers was obtained by means of direct weighing, complemented by food journals in which the foods consumed at home or out were registered using household measures. In Brazil, there are no norms that determine the standardization of utensils, which may have contributed to biases in the intake observed. Fisberg et al.¹⁸ highlight that, despite the complexity of assessing diets, and keeping in mind the recognized imperfection of dietary surveys, this method can provide data that are indispensable in pinpointing dietary conducts. On the other hand, we did not investigate the consumption of vitamin and mineral supplements that were potentially included in the diets²⁴.

CONCLUSION

The use of EAR as a cut-off point applied to individuals identified that 62.2% and 91.2% of the children have adequate amounts of Vitamin C and Iron in their diets, respectively. According to the EAR, this is an expected result. In relation to the RDA, the percentages reached 0.4 and 2.5.

The DRI represent the most thorough set of nutrient reference values developed for planning and assessing habitual food intake. Considering that we used the methods suggested by the Subcommittee for DRI Interpretation and Use, this study contributes in assisting professionals who work in the field of Public Health Policies.

Studying the prevalence of adequacy of Iron and Vitamin C in children's diets enables the tracking of nutritional factors that might impact interventions in populations at risk. The application of DRI allows for evaluations of causal processes and risks in nutritional safety, thus contributing towards the primary prevention of nutritional deficiencies.

In a relation of causality, the sufficient cause — that is, nutritional deficiencies — will be present when an illness occurs. In this sense, the nutrients Iron and Vitamin C were privileged here, in view of the scenario of iron deficiency anemia in Brazil, and considering that Vitamin C stimulates the absorption of heme and non-heme Iron. However, if the food intake of Iron is inadequate (necessary cause), serum concentrations are compromised even when iron deficiency anemia does not occur (hidden hunger).

Studies on the probability of diet adequacy by means of nutritional markers can reduce the probability of occurrence of nutritional deficiencies in children in comparison to others with adequate diets.

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