ARTÍCULO ORIGINAL

The importance of habitual vitamin A dietary intake on the serum retinol concentration in the elderly: a population-based study

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ABSTRACT

Introduction. The aging population is one of the main results of population demographic trends during the twentieth century and will be the hallmark of populations during this century. **Objective.** To assess the habitual dietary vitamin A intake and serum retinol concentration in the elderly. **Material and methods.** This is a population-based epidemiological study conducted in João Pessoa, Paraíba, northeastern Brazil, from July 2008 to January 2010, with 212 individuals from 60 to 90 years of age, from both genders. Habitual food intake, retinolemia and C-reactive protein (CRP), as well as socioeconomic and anthropometric data were collected. **Results.** The median of vitamin A intake was 1643.40 μg EAR/day (p25 = 1112.20-p75 = 2430.80). The average serum retinol concentration was 1.91 ± 0.68 mmol/L. There was no correlation of CRP concentration with serum retinol (r = 0.061/p = 0.424), nor with the habitual dietary retinol intake (r = 0.000/p = 0.932). However, there was a direct relationship between food intake and serum retinol concentration (r = 0.173/p = 0.025). Only 3.98% (IC95% 6.88-1.08) of subjects had inadequate serum retinol concentrations (< 1.05 μmol/L), and 12.4% (IC95% 17.36-7.44) had

La importancia de la vitamina en la ingesta alimentaria habitual en la concentración sérica de retinol en los ancianos: un estudio de base poblacional

RESUMEN

Introducción. *El envejecimiento de la población fue uno de los principales resultados de las tendencias demográficas poblaciones durante el siglo XX y será el aspecto distintivo de las poblaciones durante el siglo XXI.* ***Objetivo.*** *Evaluar el consumo alimentario habitual de vitamina A y la concentración de retinol sérico en ancianos.* ***Material y métodos.*** *Estudio epidemiológico transversal, de base poblacional, realizado en João Pessoa/PB, zona del nordeste del Brasil en el periodo de julio 2008 a enero 2010, con 212 individuos de 60 y 90 años de edad, de ambos géneros. Se colectaron datos de consumo alimentario habitual, retinolemia y proteína C-reactiva (PCR), además de aspectos socioeconómicos y antropométricos.* ***Resultados.*** *El promedio de consumo de vitamina A fue de 1643,40 μg RAE/día (p25 = 1112.20-p75 = 2430.80). La concentración promedio de retinol sérico fue de 1.91 ± 0.68 μmol/L. No hubo correlación entre concentración de PCR y retinol sérico (r = 0.061/p = 0.424),* inadequate vitamin A intake (< 625 μg for males and < 500 μg for females). Most individuals assessed in this study showed adequate retinolemia state and habitual dietary vitamin A intake, probably protecting them from this specific nutritional vulnerability, and no correlation between CRP concentration and serum and dietary retinol was found, possibly because these individuals had no acute inflammation and absence of chronic decompensated diseases.

Key words. Elderly. Serum retinol. Habitual vitamin A intake. C-reactive protein.

ni con el consumo alimentario habitual de retinol (r = 0.000/p = 0.932). Sin embargo, hubo relación directa entre el consumo y la concentración sérica de retinol (r = 0.173/p = 0.025). Solamente 3,98% (IC95% 6.88-1.08) de los individuos presentaron concentraciones de retinol sérico inadecuados (< 1.05 μmol/L) y 12.4% (IC95% 17.36-7.44) consumo de vitamina A inadecuado (< 625 μg, sexo masculino; < 500 μg, femenino). En la población se evidenció para la mayoría de los ancianos adecuado estado de retinolemia y de consumo alimentario habitual de vitamina A, protegiéndolos probablemente de esa vulnerabilidad nutricional específica; no se encontró correlación entre concentración de PCR con retinol sérico y dietético, posiblemente por tratarse de ancianos sin cuadro agudo de inflamación o con ausencia de enfermedades crónicas descompensadas.

Palabras clave. Ancianos. Retinol sérico. Consumo habitual de vitamina A. Proteína C-reactiva.

INTRODUCTION

The aging population is one of the main results of demographic trends during the twentieth century and will certainly be the hallmark of populations during this century. In 2000, the number of individuals with 60 years or older was 600 million, triple the number filed in 1950. In 2009, the number of older people exceeded 700 million.[1]

Elders appear to constitute the age group most susceptible to protein-energy malnutrition, deficiency of vitamins and minerals[2] influenced by factors such as socioeconomic, psychosocial, family and progressive physiological changes that compromise the functioning of vital organs of the digestive system.[3,4] However, there is consensus that anatomical and functional changes characteristic of aging compromise the basal metabolism, gastrointestinal function and sensory perception, which may lead to increased susceptibility of this group to states of malnutrition and specific nutrient deficiencies.[3-5]

Population-based studies conducted with elders to investigate the vitamin A status are scarce in literature. Research conducted by Nascimento, *et al.,*[2] to measure the vitamin A status of a group of elderly individuals with low socioeconomic status shows the potential state of susceptibility to this specific nutritional deficiency, by detecting the low frequency of consumption of foods sources of vitamin A, mainly of animal origin, and inadequate retinol levels in about one quarter of this population.

A recent survey conducted in South Africa by Oldewage-Theron, *et al.*[6] shows the low dietary vitamin A intake and high prevalence of vitamin A deficiency among the low-income elderly population. This study highlights the importance of the need for sustainable interventions to solve this nutritional vulnerability, especially in communities.

Vitamin A is a micronutrient essential to the maintenance of normal physiological functions, plays a key role in numerous vital functions including vision, growth, development, maintenance of epithelial tissue, reproduction and immunity. Carotenoids, which are vitamin A precursors, are potent antioxidants, and recent studies have shown that low plasma levels of carotenoids are an independent risk factor of mortality in the elderly.[7,8]

The serum retinol concentration is one of the methods used to estimate the vitamin A deficiency. However, this has strong influence in the presence of clinical and subclinical infections, which may affect the interpretation of results.[9] According to recommendations of Thurnham, *et al.*,[9] researches directed to the diagnosis of vitamin A deficiency should include the analysis of serum concentrations of acute-phase inflammatory markers such as C-reactive protein (CRP) in order to enable better expression of the vitamin A state. Studies with children and adults show a significant inverse relationship between consumption of antioxidant vitamins and serum CRP levels, as well as between serum concentrations of pro-vitamin A substances and CRP concentration.[10,11]

Although much information about vitamin A is already available, many aspects are yet to be investigated. In relation to the nutrition of the elderly individual, there are several gaps to be filled, among them the nutritional status specific of vitamin A.

OBJECTIVE

Considering the few studies involving vitamin A profile of the elderly population and the likely influence of inflammatory processes in serum concentrations of this vitamin, this research has the following objectives:

- To describe the vitamin A status of the elderly population.
- To measure CRP levels in the study population.
- To correlate the vitamin A consumption with serum retinol and the CRP values.

MATERIAL AND METHODS

This research is linked to project entitled First diagnosis and intervention of food status, nutrition and the most prevalent non-communicable diseases in the population of the city of João Pessoa/Paraíba/ Brazil (IDISANDNT /PB), conducted from July 2008 to January 2010.

A population based cross-sectional epidemiological study design was adopted. The selected population was representative of five Health Districts of the city of João Pessoa/PB and included elderly people aged between 60 and 90 years from both genders, different socioeconomic conditions with or without chronic diseases, using drugs or not. Elderly patients with neurological disorders (6 individuals) were excluded due to impossibility of performing all the procedures of the study protocol. Those who were using vitamin A supplements and carotenes (1 individual) were also excluded.

To calculate the sample size, the variable income was used starting from the premise that there is a relationship between income, prevalence of disease and nutrition.[12] The sample used was stratified due to the presence of heterogeneity of blocks. This unit was used because there was no information on the number of dwellings per district. After the application of stratified sampling, a systematic sampling was applied in 257 of the 8,206 randomly selected blocks to allow the choice of houses. The average number of dwellings per block was estimated by the amount of Real Estate Tax-IPTU. The systematization factor found was seven, totaling 722 houses. In the presence of two or more elderly at home, individuals were selected using random instrument (coin), using the heads or tails system (Table 1).

Data collection was conducted through home visits. The questionnaires was applied by teams of researchers, coordinated by Master students of the Post-Graduation Program in Nutrition Sciences (PPGCN), properly trained for the completion of the pilot study and before the beginning of the data collection.

From the contact with the family, when the presence of the elderly at home was identified and after applying the questionnaires and nutritional assessment, the researcher came into contact with the individual to facilitate the implementation of the biochemical analysis. The collection of blood samples was performed at home with the project team, composed of high level professionals (nurses) trained to perform the procedures. Each individual was cleared as a participant in this study and properly clarified regarding the objectives and procedures, confidentiality and anonymity, and explained the voluntary nature of participation. By agreeing, they signed the Clear and Free Consent Form. This study was approved by the Ethics Research Committee of the Department of Health Sciences (CCS) UFPB, under protocol No. 0493.

The indicator used to assess nutritional status was the Body Mass Index (BMI), according to the

Table 1. Calculation of the samples. Elderly from João Pessoa/PB/Brasil/2008-2010.

District	I	II	III	IV	V	Total
Neighborhoods	9	8	11	11	21	60
• Classified into 10 income strata						
Blocks	1,822	1,260	2,170	918	2,036	8,206
Blocks drawn	61	40	63	28	65	257
Households selected	166	123	179	90	164	722
Total number of subjects found in the selected households = 2030 (260 elderly)						
• Total number of subjects drawn = 1,206 (212 elderly)						
Selected and evaluated elderly	54	43	31	33	51	212
Elderly who have not finished the research protocol	5	2	5	9	15	36
Total number of elderly	49	41	26	24	36	176
Total: 176 elderly.						

classification of the World Health Organization (WHO)[13] and of Lipschitz.[14] The dietary survey was conducted by the Quantitative Food Frequency Questionnaire (QFFQ). This questionnaire refers to the number of times that food and beverages are consumed, the time unit (by day, week, month or year), the type the serving consumed (g, mL) and the serving size of each food item (small, medium, large or extra-large). Quantifying the vitamin A intake was performed with the aid of the Dietsys computer software (version 3.0).

The QFFQ was validated through three 24 hrs recalls for the female population of the municipality of João Pessoa/PB; this validation study was carried out in partnership with the School of Public Health, University of Sao Paulo and the Post-graduation Program in Nutritional Sciences at the Federal University of Paraíba.[15,16] The Estimated Average Requirement (EAR) of 625 μg of retinol/day was adopted as reference for the vitamin A intake for males, and 500 μg for females.[17] The elderly responded to the food survey, whenever possible, along with the family head, and with the aid of drawings of foods with serving sizes to more effectively quantify the size of servings consumed.[18]

For biochemical analysis, an aliquot of 4.0 mL of venous blood was collected by cubital phlebotomy performed after a 12 hrs fasting period. Immediately after collection, blood samples were placed in test tubes previously identified and protected from light. The samples were transported to the Centre for Research on Micronutrients (CIMICRON)-Lauro Wanderley University Hospital (HULW)/Federal University of Paraíba to accomplish, after complete coagulation, centrifugation at 3,000 rotation per minute for 10 min resulting in the total serum separation. The content was packed in two aliquots, one being transferred to eppendorf tubes and then stored in freezer at a temperature of -20 ºC for later analysis of serum retinol. The second aliquot was intended for analysis of C-reactive protein in clinical analysis laboratory of HULW.

The serum retinol concentrations were determined by chromatographic method, using High Pressure Liquid Chromatography-HPLC.[19] The cutoff used to identify deficient levels of serum retinol concentration was < 0.35 μmol/L (< 10 μg/dL), low was < 0.70 μmol/L (< 20 μg/dL) and inadequate levels was < 1.05 μmol/L (< 30 μg/dL). Elderly with serum retinol < 0.70 mmol/L were considered with the vitamin A deficiency.[20]

The CRP was determined by agglutination of particles through latex (Quantitative) using the Kit BioSystems PCR-hs (BioSystems: reagents & instruments, Barcelona, Spain). The cutoff points of CRP-hs for adequate levels in individuals over 60 years were < 8.5 mg/dL for females and < 7.9 mg/dL for males. In people over age 65, the values were < 6.6 mg/dL and < 6.8 mg/dL, respectively.[21]

The statistical tests applied initially involved a partial analysis of data. This was expressed by descriptive statistics represented by a single frequency, with the characterization and description of the phenomenon that was desired to study and interpret. Measurements of position such as central tendency and dispersion were used (mean, median and standard deviation). As for the distribution normality, the Lilliefors normality test was applied, which is a derivation of the Kolmogorov-Smirnov test. In a second step, an analysis was performed to verify the linear correlation between two numerical variables, using the Pearson or Spearman correlation coefficient, according to the behavior of the variables. The Fisher's exact test for small samples was also applied, comparing two groups, checking the independence of two variables and also the homogeneity of two populations. A simple regression analysis was also applied to analyze the relationships between a single dependent variable (serum retinol, CRP) and several independent variables, each corresponding to a linear regression. The variables involved in the analysis were characterized as metric. The statistical procedure was performed using the R software.[22] A significance level of 5% was adopted to reject the null hypothesis.

RESULTS

Of the total elderly selected (212 individuals), the Quantitative Food Frequency Questionnaire (QFFQ) was applied to 170 of them and biochemical evaluation was performed in 176 individuals, the losses were due to the impossibility of collecting data on the refusal of the elderly or guardians to finalize the steps of the research protocol. However, even considering the losses, the sample representativeness was maintained when considering the total number of individuals that compose the final sample, which represented 14.59% of the entire population in the randomly selected houses (1,206 individuals). This proportion is higher than the percentage of elderly in that city, which is 9.12%, according to the Institute of State and Municipal Development (IDEME/2008).

The casuistic of this study was characterized by a higher frequency of women than men ($p = 0.000$)

(Table 2). The average BMI of the sample was 27.42 kg/m^2 ± 4.74, with 65.66% of overweight and obesity when classified according to WHO (1998); however, according to the Lipschitz classification (1994), the percentage of overweight elderly was 47.59%.

The family income showed median of R$ 1,200.00/ U.S. $ 684.77 (p25 = R$ 700,00-p75 = R$ 2.800,00). When income was distributed by class, it was found that 9% belonged to the social class AB (income > R$ 4.807,00 (> U.S. $ 2.682.9267), 37.1% to social class C (income > R$ 1.115,00-R$ 4.807,00 (U.S.

Table 2. Characteristics of the elderly under study, João Pessoa/PB/Brazil, 2008-2009.

Characteristics	Mean	SD	Amplitude	n (%)
• Demographic and socioeconomic description				
Gender				
Male	-	-	-	57 (32.39)
Female	-	-	-	119 (67.61)
Age (years)	68.93	7.29	30	170 (96.59)
Weight (kg)	66.47	13.23	78.2	168 (95.45)
Height (m)	1.55	1.32	0.49	166 (94.32)
BMI (kg/m^2)	27.08	5.59	27.26	164 (93.18)
Educational level (years)				
0 years	-	-	-	15 (8.52)
Up to 9 years	-	-	-	97 (57.06)
> 9 years	-	-	-	58 (34.12)
Family income[a] (US$)	12,905,474	14,179,963	83,059,978	147 (83.52)
• Morbidities*				
Absence	-	-	-	67 (38.07)
Presence of one	-	-	-	87 (49.43)
Presence of two	-	-	-	19 (10.79)
Presence of three	-	-	-	0 (0)
• Lifestyle				
User of drugs	-	-	-	120 (68.18)
Drugs (< 3 units)	-	-	-	82 (68.33)
Drugs (≥ 3 units)	-	-	-	38 (31.67)
Smokers	-	-	-	17 (9.65)
Consumption of alcohol	-	-	-	39 (22.14)
Practice of physical activities†	-	-	-	47 (26.70)
• Biochemical data				
Serum retinol (μmol/L)	1.91	0.68	4.87	176 (100)
C-reactive protein (CRP) (mg/dL)	2.98	3.78	28.6	173 (98.30)
• Habitual dietary intake				
Vitamin A (μg EAR/day)[b]	2069.82	1467.52	9011.6	170 (96.59)
Dietary retinol (μg/day)[c]	705.06	1039.12	7617	170 (96.59)
• Food consumption adequacy ‡				
Group of vegetables	-	-	-	82 (46.59)
Group of fruits	-	-	-	89 (50.57)
Group of dairy	-	-	-	33 (18.75)
Group of meats	-	-	-	170 (96.59)

*Main morbidities (hypertension, diabetes and depression). †Practice of physical activities: 3 times a week for at least 30 min. ‡Food consumption adequacy (BRAZIL, Ministry of Health Food Guide for the Brazilian population, 2006/USDA. U.S. Department of Agriculture. Dietary Guidelines for Americans 2005. [a] Income: median = US$ 722, 2607 (p25 = 421, 3187-p75 = 1685, 2749). [b] Vitamin A: median = 1643.40 μg EAR/day (p25 = 1112.20-p75 = 2430.80). [c] Dietary retinol: median = 347.60 μg (p25 = 151.60-p75 = 760.95); Coefficient of variation (C_v) serum retinol: C_v = 0.36; PCR: C_v = 1.27.

$622.3140-U.S. $2.682.9267), 19.7% to the social class D (income > R$ 768,00-R$ 1.115,00 (> U.S. $428.6432-U.S. $622.3140), and 23.6% in social class E (income up to R$ 768.00 (U.S. $428.6432).[23] No relationship was found between vitamin A intake and income ($r = 0.047/p = 0.560$). Still considering the socioeconomic aspects, it was found that 21.6% of the elderly lived alone.

The average vitamin A intake was 2069.82 μg EAR/day ± 1467.52 and median of 1643.40 μg EAR/day (p25 = 1112.20-p75 = 2430.80). The vitamin A intake was assessed based on the percentage of adequacy in relation to the Dietary Reference Intake (DRIs), according to the estimated average requirement (EAR) in units of equivalents of activity of Retinol-EAR/day[17] (Table 3). When the consumption by food groups was measured, there was a higher percentage (96.59%) of adequacy of the number of servings for the meat group, whose recommendation is 1 serving/day, with an average of 2 servings daily. A high number of individuals who had adequate intake of fruit group (3-5 servings/day) and vegetable group (3-5 servings/day) were observed (Table 2).

The average serum retinol concentration was 1.91 μmol/L (54 μg/dL) and standard deviation of 0.68 μmol/L (19 μg/dL) (Table 2). The linear regression analysis between serum retinol levels and vitamin A dietary intake shows a positive relationship ($r = 0.173/p = 0.025$) (Figure 1). There was also an association, when using the median of vitamin A dietary intake and serum retinol concentration ($p = 0.000$).

The serum retinol concentrations in the age group of 60-65 years was 1.85 ± 0.58 μmol/L and increased progressively until the age of 85-90 years. In this age group, the value was 2.04 ± 0.68 μmol/L,

Table 3. Classification on the percentage of dietary vitamin A adequacy (EAR), serum retinol concentration and C-reactive protein in elderly from João Pessoa/PB/Brazil, 2008-2009.

Indicators	Males (M)		Females (F)	
	Adequate N (%)	Inadequate N (%)	Adequate N (%)	Inadequate N (%)
Vitamin A (µgEAR/day)*	48 (84.21)	9 (15.79)	106 (89.08)	13 (10.92)
Serum retinol (µmol/L)†	54 (94.74)	3 (5.26)	116 (97.48)	3 (2.52)
C-reactive protein (CRP)‡	54 (94.74)	3 (5.26)	107 (89.92)	12 (10.08)

*Adequate vitamin A (EAR): ≥ 625 µg EAR (sex M) and ≥ 500 µg EAR (sex F). Inadequate: < 625 µg EAR (sex M) and < 500 µg EAR (Sex F). †Adequate serum retinol ≥ 1.05 µmol/L/Inadequate: < 1.05 mmol/L. ‡Adequate CRP: < 7.9 mg/dL (sex M), < 8.5 mg/dL (sex F). Inadequate: ≥ 7.9 mg/dL (sex M) and ≥ 8.5 mg/dL (sex F).

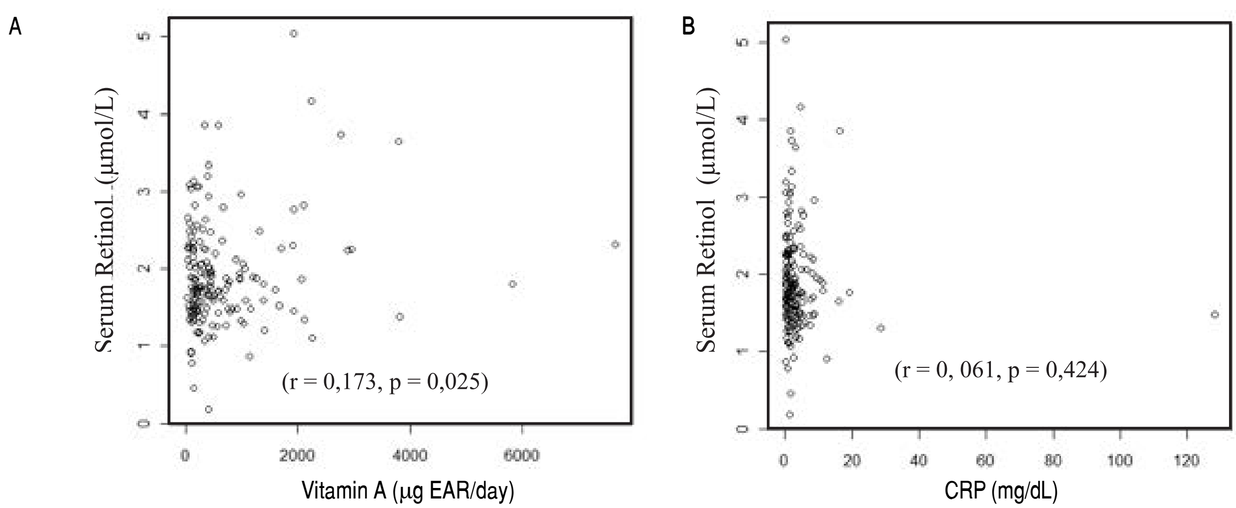

Figure 1. A. Relationship between habitual dietary vitamin A intake (µg EAR/day) and serum retinol (µmol/L). B. Relationship between CRP (mg/dL) and Serum retinol (µmol/L).

although no correlation between serum retinol and age was found (p = 0.280) (Figure 2). Only 3.98% (CI95% 6.88-1.08) of subjects had serum retinol concentrations rated as inadequate (< 1.05 μmol/L) and 1.14% (CI95% 2.71-0.43) had retinol levels < 0.70 μmol/L (Table 4). The serum retinol levels distribution did not differ between genders (p = 0.908) and no statistical difference in the retinol consumption by gender was found (p = 0.580).

The CRP values were normal for 91.43% of the elderly and the correlation analysis revealed no association between CRP and serum retinol (r = 0.061/p = 0.424) (Figure 1), nor between CRP and retinol consumption (r = 0.000/p = 0.932).

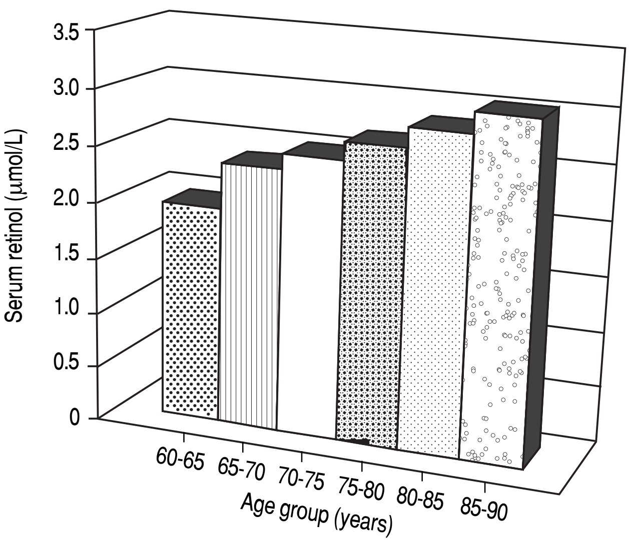

Figure 2. Mean serum retinol levels by age of the elderly from the city of João Pessoa/PB/Brazil, 2008-2010.

DISCUSSION

The aging population is now a global phenomenon and has become a major concern in the health field. In 2050, over 2 billion older individuals are expected, which implies that their number will once again triple over a period of 50 years.[1] This reality must be viewed from the perspective of providing a better quality of life in this age group, aiming to lower costs to public health.

The higher frequency of women found in this study reflects the global reality of feminization in elderly groups of the population. Women reach older ages than men in a vast majority of countries, which is a phenomenon observed throughout the world.[24]

When considering the nutritional status, a significant prevalence of overweight and obesity was observed among the elderly of this study, which

Table 4. Distribution of elderly according to the serum retinol concentration by sex, age and BMI, João Pessoa/PB/Brazil, 2008-2009.

Indicators	N	Serum retinol (μmol/L) Mean	SD	Prevalence Desirable[a] N (%)	Threshold[b] N (%)	Low[c] N (%)	Deficient[d] N (%)
• Total	176	1.91	0.68	169 (96.02)	5 (2.84)	1 (0.57)	1 (0.57)
• Gender*							
Male	57	1.94	0.73	54 (94.75)	1 (1.75)	1 (1.75)	1 (1.75)
Female	119	1.89	0.65	117 (98.32)	2 (1.68)	0 (0)	0 (0)
• Age group†							
60-65	62	1.85	0.58	60 (96.77)	2 (3.23)	0 (0)	0 (0)
65-70	37	1.93	0.78	36 (97.30)	1 (2.70)	0 (0)	0 (0)
70-75	37	1.99	0.81	35 (94.59)	1 (2.70)	0 (0)	1 (2.70)
75-80	18	2.01	0.48	18 (100)	0 (0)	0 (0)	0 (0)
80-85	8	1.63	0.60	7 (87.50)	0 (0)	1 (12.50)	0 (0)
85-90	8	2.04	0.68	7 (87.50)	1 (12.50)	0 (0)	0 (0)
• BMI (kg/m^2)‡							
Slimness (< 22)	17	2.16	0.76	17 (100)	0 (0)	0 (0)	0 (0)
Normal (22-27)	70	1.82	0.64	68 (97.14)	1 (1.43)	1 (1.43)	0 (0)
Overweight (> 27)	77	1.95	0.70	74 (96.10)	3 (3.90)	0 (0)	0 (0)

*χ^2 test for serum retinol and sex (p = 0.908). † Fisher's exact test for serum retinol and age group (p = 0.280). ‡ Spearman test for serum retinol and BMI (p = 0.639). Prevalence: [a] (≥ 1.05 μmol/L). [b] (1.05 to 0.70 μmol/L). [c] (< 0.70 μmol/L). [d] (< 0.35 μmol/L).

expresses a challenge for public agencies, since obesity has been consistently associated with increased risk of cardiovascular diseases, diabetes and various types of cancers and other chronic diseases.[25]

As for income, the lack of relationship between income and consumption of vitamin A can be attributed to the higher purchasing power of the intermediate classes, since, according to Lima, *et al.*[26] estimates indicate that the Northeast region of Brazil showed expressive mobility of people from low-income stratum to the middle-income stratum, and the Brazilian population is experiencing a transition period in which there is greater demand and supply of health services, accompanied by improvements in sanitation, as well as reduction of severe malnutrition and infant mortality. For scholars, the recent trend of improvement in income distribution and poverty reduction in Brazil would be a consequence of the economic growth reactivation.[27] This new reality has probably changed the food intake of the population, whereas, according to literature, socioeconomic factors like education level and income are important determinants of the low food consumption, primarily for the consumption of fruits and vegetables.[28]

Regarding food intake, the Brazilian Food Guide from the Ministry of Health (BRAZIL)[29] recommends consuming three daily servings of vegetables and fruits, as well as three servings of milk and/or derivative and one serving of meat, which may be equivalent to a grilled steak of 64 or 80 g of cooked meat or roasted pork loin or 100 g of grilled chicken fillet, baked swordfish or poached egg.[30] When considering the guidelines of the American Food Guide (USDA),[31] which recommendation is to consume two or fewer daily meat servings, or a portion equal to 3 Oz (84 g) on a diet of up to 2,600 calories. It was observed that most of the casuistic showed met the guidelines in relation to consumption of the meat group, in which vitamin A has better bioavailability.[32] As for the fat group, it was not possible to obtain the measurement and the intake adequacy, since the software used provides the sum of number of servings consumed from fat and sugar groups in a single group, making it impossible to differentiate the consumption from each food group.

When comparing the findings of food consumption, it was observed that a similar result was obtained by Goldbohm, *et al.*,[33] in Northern Europe, where the population studied has a higher dietary intake of vitamin A derived from meat and offal. Dissimilarly, Lucarini, *et al.*[34] evaluated the intake of vitamin A and carotenoids in the Italian population (Results of an Italian Total Diet Study) and found that the average daily consumption of this vitamin, specifically β-carotene was more significantly from the group of vegetables.

Antioxidant nutrients, particularly carotenoids in the form of β-carotene, have received special attention with reference to the nutrition of the elderly. The oxidative damage is involved in the aging process and also plays a role in many age-related degenerative diseases. The ingestion of diet with appropriate levels of antioxidant nutrients could be vital to promoting health, wellness and longevity of the elderly. Although antioxidants are important to improve the immune function of the elderly,[35] the literature supports the hypothesis that longevity is associated with favorable antioxidant status.[36]

Meoci, *et al.*[37] conducted a study among hundred-year-old healthy individuals and observed a consistent behavior in the antioxidant pattern and found that high vitamin A and vitamin E levels in the blood appeared to be associated with extreme longevity of these individuals. Data from the National Health and Nutrition Examination Survey (NHANES III) indicate that serum retinol levels increased significantly with age, and men had higher mean values than women.[38] Although no relationship was found between serum retinol and age, in the present study, it was observed that the mean serum retinol showed an increase trend in the age group of 60-65 years until the age of 85-90 years, even when dealing with a population in which 37.07% of the elderly were healthy and 60.22% had compensated chronic degenerative diseases.

When analyzing the average serum retinol concentration of individuals of this study, it was found that most individuals had adequate serum retinol concentration and these data corroborate the findings of Cheng, *et al.*,[39] who showed a mean serum retinol concentration of 2.73 μmol/L, and 99.52% of the elderly population in Taiwan showed normal plasma vitamin A levels, and still according to the author, the dietary vitamin A intake (2.758 μgRAE/day) in the elderly population of Taiwan is equivalent to 1.9 times the Recommended Dietary Allowance (RDA). This proportion is close to that found in this study, in which the average vitamin A intake (μg EAR/day) was equivalent to 2.2 times the current RDA reference values.[17]

In a prospective double-blind randomized study conducted by Polito, *et al.*,[40] in which none of elderly Europeans tested showed biochemical evidence of vitamin A deficiency. The mean retinol alterations were between 1.88 μmol/L and 2.20 μmol/L. It should be stressed that the European elderly population studied showed a high fat intake (36-40% of total calories), a value higher than the average percentage of habitual fat intake of the subjects from this study, which was 28% of total calories. In the study by Tomita, *et al.*,[41] low-income middle-aged Brazilian women show adequate serum retinol levels according to the Food and Nutrition Board, with a mean value of 1.73 μmol/L and intake of fruits and specific vegetables was an independent predictor of total serum carotenoids, although the consumption of fruits and vegetables was below the World Health Organization recommendations, and the consumption was higher among nonsmokers compared to smokers. According to Russel,[42] the proper retinolemia in the elderly could be related to the fact that the hepatic supply remains well preserved during aging. The author also reports that there is evidence that the absorption of vitamin A would increase during the aging process due to physiological changes of the intestinal mucosa.

The presence of vitamin A plays an important role in the prevention or attenuation of physiological changes such as the prevention of severe cataract and age-related senile macular degeneration,[43,44] immune modulation[45] and inflammatory processes.[46] The adequate vitamin A intake, represented by normal serum retinol levels, becomes relevant for the health promotion among elderly people and its deficiency can be an aggravating factor for some diseases that affect this specific group of individuals. Nascimento, *et al.*,[2] in a study conducted with older adults attended by the public health network, observed a prevalence of 9.2% for low serum retinol values (< 0.70 μmol/L), which is lower to those found in hospitalized elderly (13.2%),[47] in rural communities of Guatemala (21%),[48] and low-income African elderly (28.2% in men and 26.5% in women).[6] In this study, the prevalence was of 1.14% was found, a value close to that found in the Second National Health and Nutrition Examination, which was 1.8%.[48]

The serum retinol and retinol intake values were similar between genders, a fact also observed in literature.[2,39] These findings are considered unexpected by Nascimento, *et al.*,[2] when compared with the distribution in children at preschool age, in which the susceptibility to vitamin A deficiency has been significantly higher in males. Different results were reported in studies of Polito, *et al.*,[40] Stephensen and Gildengorin,[38] Costa, *et al.*,[49] and Hallfrisch, *et al.*,[50] in which the serum retinol values were higher in men than in women, probably due to higher consumption of foods rich in vitamin A by men.

The literature researched did not show studies linking CRP concentrations to serum and dietary retinol levels. In this study, no relationship was observed between serum retinol concentration and habitual dietary vitamin A intake with CRP, possibly because it is a population in which most had adequate vitamin A values, reflecting organic resistance against inflammation,[51] i.e., no individual in the population studied showed acute phase of infection, which could affect the interpretation of retinol as an indicator of vitamin A status,[38] suggesting that further studies with a larger sample should be conducted.

The relationship between the serum retinol values and vitamin A intake was an expected finding, considering that one of the factors that explain the vitamin A status is the dietary intake of this micronutrient.[2] This fact was observed in the present study, since subjects had sufficient intake of food sources of retinol, particularly foods of animal origin, with an average consumption of 705.06 μg of retinol ± 1039.12 and median of 347.60 μg of retinol, considered as a form of vitamin A of best bioavailability,[32] which leads us to infer that the consumption of groups of fruits and vegetables was adequate only for 50.57 and 46.59% of the population, respectively. However, according to the findings of Albuquerque, *et al.*,[52] low-income elders show insufficient weekly intake of foods rich in vitamin A of animal origin, associated with an extreme vulnerability to vitamin A deficiency, which suggests the need for a greater stimulus for the consumption of this nutrient, so that people can benefit from its nutritional value and potential antioxidant effects.

In general, carotenoids are less bioavailable than the preformed vitamin A, since they are linked to the matrix of vegetables. The requirements for intestinal absorption are higher than those of preformed vitamin A, and must also be enzymatically cleaved and stored as vitamin A or carotene in various tissues, which can only contribute substantially to the serum retinol levels.[2,32,53] The current conversion factors for carotenoids into retinol (24:1),[17] higher than earlier ones (12:1),[47] question the use of sources of carotenoids for combating hypovitaminosis A, although the bioconversion of carotenoids seems to be higher in individuals with vitamin A deficiency.[51,54]

The results revealed an adequate retinolemia status in the casuistic studied, which indicates that vitamin A deficiency is not a major problem for older people belonging to all socioeconomic levels in the city of João Pessoa-PB, Northeastern Brazil, a fact probably attributed to the adequate habitual intake of foods of animal origin, specifically from the meat group observed in the general population. Thus, this study showed the influence of the habitual dietary intake of preformed vitamin A in the serum retinol levels, which becomes relevant in combating vitamin A deficiency and for health promotion in this specific group of individuals.

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