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Use of vitamins and/or minerals among adults and the elderly in urban areas of Brazil: prevalence and associated factors

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Abstract *The purpose of the present study was to estimate the prevalence of vitamin and/or mineral use among urban Brazilian populations aged 20 years and over and to identify associated factors. Data from the National Survey on Access, Use and Promotion of the Rational Use of Medicines in Brazil (PNAUM) were analyzed and a population-based cross-sectional study with probability sampling was performed in urban areas of Brazil's five geographic regions from September 2013 to February 2014. The estimated prevalence of vitamin and/or mineral use was 4.8% (95%CI: 4.3-5.3), higher in women 6.4% (95%CI: 5.7-7.1) and in the elderly population 11.6% (95%CI: 10.5-12.8). Vitamin and/or mineral use was associated with the following factors: women, 60 years of age or older, economic class A/B, chronic disease(s) and self-perceived health held as average and very poor/poor. Multivitamins and multiminerals were the most used ones with 24.5% (95%CI 20.1-29.4), followed by calcium and vitamin D with 23.4% (95%CI 19.7-27.5). Data suggest that elderly women should be the reference public for actions aimed at promoting rational use. Nationwide epidemiological surveys should increase monitoring of these products to support the analysis of trends.*

Key words *Vitamins, Minerals, Micronutrients, Socioeconomic factors, Epidemiological surveys*

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Introduction

The human body requires some essential vitamins and minerals called micronutrients to maintain normal cellular and molecular functions. Although the amounts needed are rather small, micronutrient deficiency may result in considerable negative impacts on the health of individuals and society[1].

The risk of micronutrient deficiency in pregnant women[2,3] and children[4] is well-known. Although this population is considered at high risk, all life cycle stages are affected by micronutrient deficiency. In adults, it reduces their productive capacity[1] and it increases the risk of morbidities in older people[5].

When the amounts of micronutrients needed are not ensured by a normal diet alone, the possibilities of correcting that deficiency should be considered. One way to counter and treat micronutrient deficiency is the oral intake of vitamins and/or minerals in pharmaceutical form[6,7].

Taking vitamin and/or mineral products to correct nutritional deficiencies has become a worldwide habit. However, there is a concern about the risks of excessive consumption caused by a lack of professional guidance. As micronutrients available in the body are increased, indiscriminate ingestion may exceed tolerated levels, causing intoxication. Marra *et al.*[7] mention in their study an American survey of official data which showed that from 2008 to 2011, the *Food and Drug Administration* (FDA) received 6,307 reports of adverse events related to the use of dietary supplements. Of these notifications, six of the ten most notified products were multivitamins and multiminerals.

There are some controversies about the use of products containing vitamins and/or minerals. The case of vitamin D may be used as an example. Despite several clinical trials and systematic reviews of available data, there is an endless debate on the definition of an optimal vitamin D status, required daily intake and possible adverse health consequences caused by its insufficiency or deficiency[8]. Use of vitamin D to treat skeletal issues and aspects involving vitamin D in non-skeletal issues, i.e., its influence on cancer, on the reproductive system or on neurological and chronic kidney diseases has aroused interest and intrigued researchers[9,10].

In the international scenario, studies with national representation in the United States[11], Canada[12], Australia[13] and China[14] have estimated the prevalence of vitamin and/or mineral use in adult and elderly populations. In the United States, prevalence of using vitamins was 48%, minerals 39%, and multivitamins and multiminerals 31%[11]. In Canada, prevalence ranged from 31% in men aged 19 to 30 years to 67.8% in women over 71 years of age[12]. In Australia, prevalence of using multivitamins and/or multiminerals in a population between 30 and 49 years old was 22.3%[13]. On the other hand, in China, prevalence of using multivitamins and minerals varied between 0.19% and 1.01%, depending on the examined age group[14].

In Brazil, studies to assess prevalence of using vitamins, minerals and other products that are considered dietary supplements analyzed specific groups such as gym goers[15], university students[16] or populations restricted to one city[17,18]. A National Health Survey (PNS) covering Brazil entirely was conducted in 2013 and in 2019, but it did not address vitamin and/or mineral use among the adult and elderly population[19,20]. The Household Budget Survey conducted in 20172018 (POF 2017-2018), a nationwide household survey, included the National Food Survey (INA) which investigated use of supplements based on vitamins and/or minerals. Use of vitamins was reported by 10.5% and 17.4% of the adult and elderly population, respectively. Use of minerals, calcium and iron was also surveyed. The prevalence of calcium use, including calcium with vitamin D was 2.9% in the adult population and 14.8% in the elderly population. Use of iron was 2.4% in the adult population and 2.8% in the elderly population. Results regarding use of these products by INA 2017-2018 are stratified by age group and gender, but do not analyze use considering additional socioeconomic factors[21].

The highest prevalence of vitamin and/or mineral use has been observed in women, in the elderly population[11, 21-23], showing a good perception of health[24]. In addition to these factors, studies have indicated that the use of these products is related to higher income[22,25] and a higher educational level[26].

Knowing epidemiological data on the use of products containing vitamins and/or minerals by the general population is relevant for public health, since these products can modify deficient nutritional status and, if used indiscriminately, may result in potential harm. Thus, the present study aims to estimate the prevalence of vitamin and/or mineral use in the Brazilian adult and elderly population residing in urban areas by means of an epidemiological survey of national representativeness and to identify factors associated with use.

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Methodology

Data analyzed in this study were obtained from the National Survey on Access, Use and Promotion of the Rational Use of Medicines in Brazil (PNAUM), a cross-sectional population-based survey conducted in urban areas of the five Brazilian regions (North, Northeast, Midwest, Southeast and South) from September 2013 to February 2014. Details on the sampling process, data collection logistics and more information about the survey can be found in PNAUM's methodological article[27]. The study population consisted of people of all ages living in permanent private households, chosen by a complex poll with a probabilistic sample. The sample collected by PNAUM contained 41,433 people who, after adjusting for region, sex and age, represent the approximately 171 million Brazilians residing in urban areas, according to the 2010 Census.

For this study, an excerpt was obtained from PNAUM's database, choosing subjects aged 20 years or more as inclusion criteria. Respondents aged 20 or over totaled 32,348 people. Pregnant women were not included in the analyzes because they are in a physiological state that requires different nutrients. After disregarding pregnant women (n = 291), the population chosen for this study consisted of 32,057 people.

Data collection

Interviews were conducted face to face by trained interviewers and data were recorded on tablets using a specifically developed software program. The research instrument consisted of a set of questionnaires that included questions about the current use of medications for specific chronic diseases (hypertension, diabetes, heart disease, high cholesterol, history of stroke, chronic lung disease, arthritis, arthrosis or rheumatism, depression and other chronic illnesses) and use 15 days before the survey to investigate signs, symptoms and acute or occasional conditions treated with medication (infection, medication for sleeping, for the nerves, for stomach or intestinal problems, for fever, pain, flu, cold or allergic rhinitis, vitamin supplement, appetite stimulant or tonic, as well as other acute situations). In PNAUM, medications and their patterns of use were identified according to their use in the treatment of chronic or acute conditions and the reasons for their use.

Prevalence rates of vitamin and/or mineral use were obtained by asking: "In the last 15 days, did you use any vitamin, mineral supplement, appetite stimulant or tonic?" If the answer was "yes", we asked respondents which product(s) they were using, which allowed us to obtain vitamin and/or mineral names and to exclude products that were not the aim of this study, i.e., appetite stimulants and tonics. In addition to the answers obtained to the above-mentioned question, we also reviewed all medications listed in the questions related to chronic diseases to obtain information on vitamin and/or mineral use in these groups.

Product classification

The mentioned products containing vitamins and/or minerals were included in the analysis. The study did not consider the legal classification of medicines or food supplements. We also excluded products identified as food, food supplements, food supplementation for specific groups of patients, amino acid-based supplements, fatty acid compounds not associated with vitamins and/or minerals, and products containing vitamins and/or minerals whose formula contained other medicine. Minerals were not differentiated as to their salts for classification purposes.

Products identified as vitamins and/or minerals were classified into: *monocomponent vitamins or associated with each other*; *monocomponent minerals or associated with each other*; *associated vitamins and minerals*; *vitamins and/or minerals associated with medicinal plants, amino acids or fatty acids*.

After that, products were classified according to the components mentioned in their inserts and/or on their labels (Chart 1). Multivitamins and multiminerals were defined as such if they contained ten or more vitamins/minerals, as defined in other studies[11,28].

To analyze product use, substances containing calcium and iron were grouped together. Grouping of calcium, called calcium and associations, included the following substances: calcium; calcium and magnesium; calcium and multivitamins; calcium and vitamin D; calcium, fluorine, phosphorus, vitamin B12 and vitamin D; calcium, fluorine, vitamin B12 and vitamin D; calcium, magnesium and vitamin D; calcium, magnesium, vitamin K and vitamin D; calcium, vitamin K and vitamin D; calcium, vitamin B12 and vitamin D; calcium, zinc, phosphorus, vitamin B12 and vitamin D. The iron grouping, called iron and associations, included the following substances: iron; iron and folic acid; iron and multivitamin; iron

and phosphorus; iron and vitamin C; iron and B vitamins; iron, phosphorus and B vitamins; iron, phosphorus, magnesium and B vitamins; iron, vitamin C and B vitamins; iron, phosphorus and association of medicinal plants.

Variables under study

Analyzed sociodemographic features included: gender (male and female); age range in years (20-39, 40-59, 60-99); education in full years of study (0 to 5, from 6 to 8, from 9 to 11 and over 12) ; economic classification (A/B, C, D/E) , according to the Brazil Economic Classification Criteria developed by the Brazilian Association of Survey Companies (CCEB 2013/ABEP – http://www.abep.org) and region of residence in Brazil (North, Northeast, Midwest, Southeast, South). The health condition feature was also investigated (presence of chronic diseases: none, presence of a chronic disease, or presence of two or more chronic diseases), as well as perceived health (self-perceived health: very good/good, fair, very bad/bad).

Data analysis

Estimates of vitamin and/or mineral use prevalence rates, sociodemographic features, health condition and self-perception of health were expressed in relative frequency using 95% confidence intervals (95%CI). All percentages were adjusted by sample weights and by post-stratification according to age and sex.

The logistic regression model was used to estimate the odds ratios (OR) and the respective

Chart 1. Classification of substances included in the study analyses. PNAUM, Brazil, 2014.

Classification	Substances
Monocomponent vitamins or associated with each other	Folic acid; folic acid and vitamin D; folic acid and vitamin E; calcitriol; multivitamin; vitamin A; vitamin A and vitamin C; vitamin A and vitamin D; B complex vitamins and vitamin C; Complex B vitamins; vitamin B1; vitamin B2; vitamin B3; vitamin B6; B12 vitamin; vitamin C; vitamin D; vitamin E vitamin B1.
Monocomponent minerals or associated with each other	Calcium; calcium and magnesium; iron; iron and phosphorus; magnesium; magnesium and potassium; potassium; selenium; selenium and chromium; silicon; zinc.
Associated vitamins and minerals	Calcium and vitamin D; calcium, fluorine, phosphorus, vitamin B12 and vitamin D; calcium, fluorine, vitamin B12 and vitamin D; calcium, magnesium and vitamin D; calcium, magnesium, vitamin K and vitamin D; calcium, magnesium, manganese, zinc and vitamin D; calcium, vitamin K and vitamin D; calcium, vitamin B6, vitamin C and vitamin D; calcium, vitamin B12 and vitamin D; calcium, zinc, phosphorus, vitamin B12 and vitamin D; calcium, zinc, copper, magnesium, manganese, vitamin C and vitamin D; iron and folic acid; iron, vitamin C and B vitamins; iron and vitamin C; iron and B vitamins; iron, phosphorus and B vitamins; iron, phosphorus, magnesium and B vitamins; magnesium and vitamin B3; magnesium and vitamin B6; multivitamin and multimineral product; zinc and vitamin C.
Vitamins and/ or minerals associated with medicinal plants, amino acids or fatty acids	B-complex amino acids and vitamins; amino acids and vitamin B12; amino acids, collagen and multivitamin; amino acids, collagen and multivitamins and multiminerals; amino acids and multivitamins and multiminerals; arginine and vitamin C; association of medicinal plants, iron and phosphorus; horse chestnut and vitamin P; horse chestnut, vitamin C and vitamin P; collagen, sodium and vitamin D; gelatin, vitamin A and vitamin C; ginseng, B vitamins and vitamin E; ginseng, amino acids, multivitamin and multiminerals; ginseng and multivitamin and multiminerals; glutamine, calcium, phosphorus and vitamin B6; guarana, B complex vitamins and vitamin C; glutein and multivitamin and multiminerals; lutein, zeaxanthin and multivitamin and multiminerals; cod liver oil, vitamin A and vitamin D; linseed oil, lycopene, lutein, zinc, selenium, vitamin A, vitamin C and vitamin E; omega 3 and vitamin E; omega 3 and B complex vitamins; omega 3, lutein, zeaxanthin, selenium and vitamins A; omega 3 and multivitamin and multiminerals; plantago ovata, chitosan, chromium, vitamin B7 and vitamin C; plantago ovata, collagen and vitamin C; uc II, manganese, copper and zinc; keratin, cystine and vitamin B1.

Source: National Survey on Access, Use and Promotion of Rational Use of Medicines in Brazil (PNAUM), 2014.

95%CI, significance level 0.05, considering the effect of the sampling design, i.e., the complex sampling plan. Initially, an unadjusted analysis was performed using simple logistic regression. After that, a multivariate logistic regression analysis was performed by calculating the adjusted ORs. The entry criterion of the adjustment variables for the multivariate model followed the descriptive level: the independent variables with a $p < 0.20$ of the unadjusted analysis were included in the multivariate model and the variables with a $p < 0.05$ remained in the final model.

We performed an analysis of the ten substances most used by users of products containing vitamins and/or minerals. Results are presented in relative frequency with a 95%CI. All percentages were adjusted by sample weights and by post-stratification according to age and sex.

Analysis of use was based on information on products classified as multivitamins and multiminerals, products containing substances with calcium and products containing substances with iron. The analysis considered the reason of use (chronic illness or occasional/acute health situation) and the main reasons of use reported. The results of this analysis considered the complex plane and were expressed in relative frequency with a respective 95%CI.

Analyzes were performed using the statistical software program PASW Statistics 18.0 for Windows (SPSS Inc., Chicago, United States). To ensure the necessary weighting, the appropriate set of CSPLAN commands was used to analyze complex samples.

Ethical considerations

The study was approved by the National Research Ethics Committee (CONEP), expert opinion 398.131 of September 16, 2013. All interviews were only performed after respondents (or their legal guardian) had fully read and signed the Free and Informed Consent Term (TCLE).

Results

Of the total of 32,057 subjects who participated in this study, 1,679 answered that they use products containing vitamins and/or minerals. The overall prevalence of vitamin and/or mineral use in the study population was 4.8% (95%CI 4.3-5.3). It was higher in women, in subjects aged over 60 years, in individuals with more than 12 years of education, in economic class A/B, in the Northeast and Southeast regions, in subjects with two or more chronic diseases and in subjects with poor/very poor self-perceived health. Table 1 presents the sample distribution and estimated prevalence rates.

Women showed a prevalence of vitamin and/or mineral use of 6.4% (95%CI 5.7-7.1), more than twice as high as men, who showed a prevalence of 3.0% (95%CI 2.5-3.6). Prevalence of vitamin and/or mineral use increased with age. People over 60 years showed a prevalence of 11.6% (95%CI 10.5-12.8), the 40-59 age group showed a prevalence of 3.9% (95%CI 3.4-4.5) and the 20-39 age group showed a prevalence of 2.6% (95%CI 2.1-3.3) (Table 1).

In the unadjusted analysis, the following factors were associated with vitamin and/or mineral use: women (OR 2.18; 95%CI 1.76-2.70), age group 40-59 years (OR 1.51; 95%CI 1.15-1.99), age equal to or greater than 60 years (OR 4.85; 95%CI 3.78-6.22), economic class A/B (OR 1.45; 95%CI 1.12–1.89), living in the Northeast (OR 1.43; 95%CI 1.09-1.87), living in the Southeast (OR 1.39; 95%CI 1.03-1.88), one chronic disease (OR 2.38; 95%CI 1.91-2.97), two or more chronic diseases (OR 6.69; 95%CI 5.38-8.31), fair self-perceived health (OR 2.54; 95%CI 2.10-3.08), very poor/poor self-perceived health (OR 3.45; 95%CI 2.63-4.53) (Table 2).

The adjusted analysis showed the following results: women (OR 1.78; 95%CI 1.44-2.20), age equal to or greater than 60 years (OR 2.39; 95%CI 1.82-3.13), economic class A/B (OR 1.77; 95%CI 1.36-2.29), one chronic disease (OR 1.62; 95%CI 1.28-2.06), two or more chronic diseases (OR 3.49; 95%CI 2.64-4.60), fair self-perceived health (OR 1.37; 95%CI 1.10-1.71), very poor/poor self-perceived health (OR 1.52; 95%CI 1.12-2.05). After the adjustment, the factor "living in the South of Brazil" was associated with the results (OR 0.73; 95%CI 0.54-0.98) (Table 2).

The ten most used substances and their frequency of use among users of vitamins and/or minerals are shown in Figure 1. Multivitamins and multiminerals showed a frequency of use of 24.5% (95%CI 20.1-29.4), whereas calcium and vitamin D showed a frequency of use of 23.4% (95%CI 19.7-27.5).

The study population reported using 51,172 products, of which 1,966 were classified as vitamins and/or minerals, representing 3.8% of all products listed in the survey. Of the mentioned products under study, 47.2% were associated vitamins and minerals, 28.8% monocomponent vitamins or vitamins associated with each other, 14.3% monocomponent minerals or minerals associated with each other, and 9.7% vitamins and/

or minerals associated with medicinal plants, fatty acids and/or amino acids.

The analysis of use showed that multivitamins and multiminerals were used by 95.7% (95%CI 92.4-97.6) in acute/occasional health situations and that the main reason for use was supplementation, 86.3% (95%CI 77.7-92.0). Products containing calcium and associations were used to help treat chronic diseases by 63.3% (95%CI 57.4-68.8) and the main reason for use was joint disease treatment 40.9% (95%CI 34 .6-47.6). Iron products and associations were used by 83.7% (95%CI 76.0-89.2) in acute/occasional health situations and the main reason for use was supplementation, 75.5% (95%CI 67.6-82.1) (Table 3).

Discussion

Prevalence of vitamin and/or mineral use was 4.8% (95%CI 4.3-5.3) in the Brazilian adult and elderly population residing in urban areas. Pregnant women were excluded from the analyses. This prevalence rate is lower than the ones revealed by INA data, which were included in the 20172018 POF and showed vitamin use of 10.5% among the adult population and of 17.4% among the elderly population. Use of calcium, including calcium with vitamin D, was 2.9% among the adult population and 14.8% among the elderly population. Iron use was 2.4% and 2.8% among the adult population and among the elderly population, respectively[21]. To compare INA's results with PNAUM's results, we need to consider the

Table 1. Distribution of the sample and prevalence of vitamin and/or mineral use in the Brazilian urban population (>= 20 years of age) according to sociodemographic data, health condition and self-perceived health. PNAUM, 2014 (n = 32,057).

Features		Sample distribution		Prevalence of vitamin and/or mineral use	
		% a	CI95%	% a	CI95%
Sex	Male	46.6	45.6-47.7	3.0	2.5-3.6
	Female	53.4	52.3-54.4	6.4	5.7-7.1
Age range (years)	20-39	44.9	43.1-46.7	2.6	2.1-3.3
	40-59	36.2	34.8-37.6	3.9	3.4-4.5
	60 -99	18.9	17.9-19.9	11.6	10.5-12.8
Education [b]	0 to 5 years	43.9	42.3-45.5	4.5	4.0-5.1
	6 to 8 years	14.5	13.7-15.3	4.5	3.7-5.6
	9 to 11 years	30.5	29.3-31.8	5.0	4.4-5.7
	12 or more years	11.1	10.1-12.1	5.5	4.2-7.2
CCEB [c]	D/E	20.7	19.1-22.5	4.3	3.6-5.0
	C	55.1	53.4-56.7	4.4	4.0-4.9
	A/B	24.2	22.1-26.4	6.1	5.0-7.4
Brazilian region	North	6.7	5.2-8.4	3.7	3.0-4.7
	Northeast	23.4	19.3-28.1	5.2	4.7-5.9
	Southeast	47.5	41.7-53.4	5.1	4.3-6.1
	South	14.7	11.8-18.1	3.9	3.2-4.6
	Midwest	7.8	6.1-9.9	4.2	3.4-5.3
Presence of chronic disease	None	64.9	63.6-66.1	2.4	2.0-2.9
	One	20.7	19.9-21.6	5.6	4.9-6.5
	Two or more	14.4	13.6-15.3	14.3	12.7-16.0
Self-perceived health	Very high/high	73.8	72.4-75.3	3.4	3.0-4.0
	Average	22.5	21.2-23.7	8.3	7.4-9.3
	very poor/poor	3.7	3.4-4.1	10.9	8.7-13.6
Total				4.8	4.3-5.3

95%CI: 95% confidence interval. [a] Percentage adjusted by sample weights and post-stratification according to age and gender.[b] Full years of study. [c] Brazil Economic Classification Criteria 2013 (CCEB 2013) of the Brazilian Association of Survey Companies (ABEP). Available at: http://www.abep.org.

Source: National Survey on Access, Use and Promotion of Rational Use of Medicines in Brazil (PNAUM), 2014.

Table 2. Estimated odds ratios (OR), unadjusted and adjusted, of vitamin and/or mineral use in the Brazilian urban population (>= 20 years) according to sociodemographic data, health condition and self-perceived health. PNAUM, 2014 (n = 32,057).

Features		Unadjusted analysis			Adjusted analysis a		
		OR	CI95%	P b	OR	CI95%	P b
Sex	Male	Ref.		< 0.0001*	Ref.		< 0.0001*
	Female	2.18	1.76-2.70		1.78	1.44-2.20	
Age range (years)	20-39	Ref.		< 0.0001*	Ref.		< 0.0001*
	40-59	1.51	1.15-1.99		1.02	0.76-1.37	
	60 - 99	4.85	3.78-6.22		2.39	1.82-3.13	
Education [c]	0 to 5	Ref.		0.275			
	6 to 8	1.01	0.80-1.27				
	9 to 11	1.12	0.96-1.32				
	12 or more	1.24	0.94-1.63				
CCEB[d]	D/E	Ref.		0.007	Ref.		< 0.0001*
	C	1.04	0.85-1.27		1.12	0.91-1.38	
	A/B	1.45	1.12-1.89		1.77	1.36-2.29	
Brazilian Region	North	Ref.		0.010	Ref.		0.004
	Northeast	1.43	1.09-1.87		1.14	0.86-1.51	
	Southeast	1.39	1.03 -1.88		0.95	0.71-1.29	
	South	1.04	0.77-1.40		0.73	0.54-0.98	
	Midwest	1.14	0.82-1.58		0.83	0.60-1.15	
Presence of chronic disease	None	Ref.		< 0.0001*	Ref.		< 0.0001*
	One	2.38	1.91-2.97		1.62	1.28-2.06	
	Two or more	6.69	5.38-8.31		3.49	2.64-4.60	
Self-perceived health	Very high/high	Ref.		< 0.0001*	Ref.		0.005
	Average	2,54	2,10-3,08		1,37	1,10-1,71	
	Very poor/poor	3,45	2,63-4,53		1,52	1,12-2,05	

95%CI: 95% confidence interval. OR: odds ratio. Ref.: reference category. * p < 0.01. a Adjusted by sex, age group, economic classification, Brazilian region, presence of chronic disease and self-rated health. b Wald test. c Full years of study. d Brazil Economic Classification Criteria 2013 (CCEB 2013) of the Brazilian Association of Survey Companies (ABEP). Available at: http://www.abep.org.

Source: National Survey on Access, Use and Promotion of Rational Use of Medicines in Brazil (PNAUM), 2014.

methodological differences of the surveys. First, the question included in the data collection questionnaires uses different recall periods: INA adopted a longer recall period (30 days), PNAUM a shorter one (15 days). Data presented by INA for the use of dietary supplements included pregnant women, which causes differences in the prevalence rates of the adult population. INA, a POF subsample, includes seasonality, i.e., data are collected over 12 months, thus including all seasons of the year, but PNAUM does not. In addition, INA includes residents of urban and rural areas, but PNAUM includes residents of urban areas only. Finally, it should be considered that those surveys adopt different approaches: INA investigates diet features, whereas PNAUM analyzes use of medications.

Vitamin and/or mineral use in both INA and PNAUM showed the highest prevalence in women and in the elderly population. Patterns of use identified by sex and age group are similar to findings of a North American study that assessed trends of use of dietary supplements based on data from 1999 to 2012 from the National Health and Nutrition Examination Survey (NHANES)[11]. In Canada, analyses performed with data from the Canadian Community Health Survey (CCHS) also found that same pattern[12,22,23]. In the adjusted analysis, which aims to control possible confounding factors, the OR of women and subjects aged over 60 years show a significant decrease when compared to the values obtained by the unadjusted analysis. Although these factors remain associated with the outcome, it can

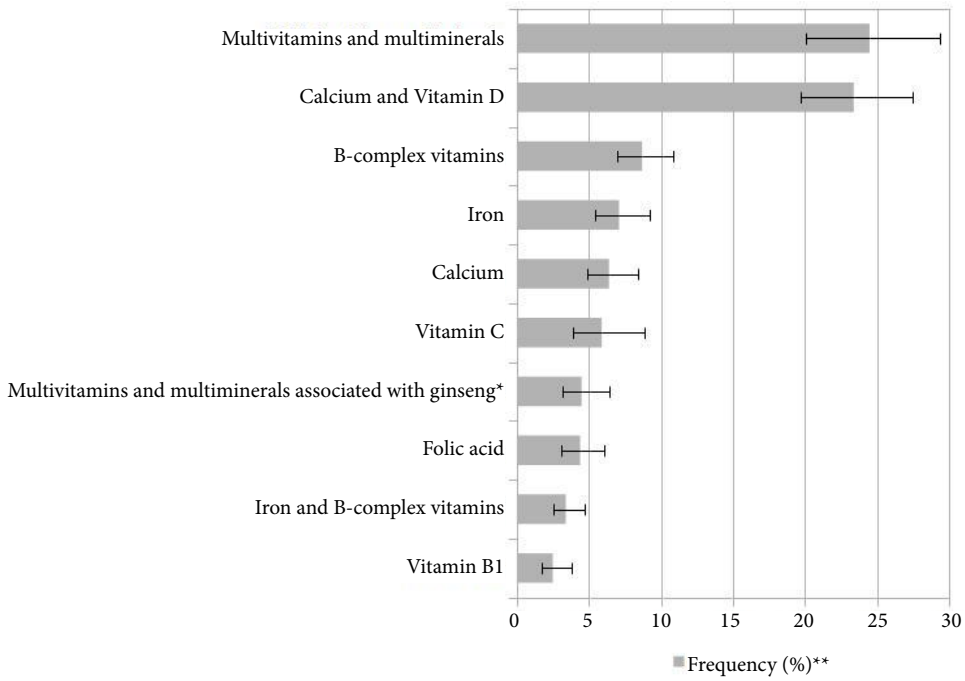

Figure 1. Ten most mentioned substances and their frequency of use among vitamin and/or mineral users. PNAUM, Brazil, 2014 (n = 1,679 users).

* Refers to Panax ginseng. ** Percentage adjusted by sample weights and post-stratification according to sex and age.

Source: National Survey on Access, Use and Promotion of Rational Use of Medicines in Brazil (PNAUM), 2014.

Table 3. Analysis of use of multivitamin and multimineral products. products containing calcium and associations. and products containing iron and associations in terms of features and main reasons for use. PNAUM. Brazil. 2014.

	Multivitamin and multiminerals (n = 336) *		Calcium and associations (n = 582) *		Iron and associations (n = 249) *	
Used for	**%**		**%**		**%**	
	(CI95%)		**(CI95%)**		**(CI95%)**	
Chronic disease	4.3		63.3		16.3	
	(2.4-7.6)		(57.4-68.8)		(10.8-24.0)	
Acute/ occasional conditions	95.7		36.7		83.7	
	(92.4-97.6)		(31.2-42.6)		(76.0-89.2)	
Principais motivos de uso						
	Vitamin supplement	86.3 (77.7-92.0)	Joint disease	40.9 (34.6-47.6)	Vitamin supplement	75.5 (67.6-82.1)
	Other acute conditions	3.7† (0.8-15.4)	Vitamin supplement	28.6 (23.6-34.2)	Other chronic diseases [b]	14.8 (9.5-22.4)

95%CI: 95% confidence interval. * Refers to products. [a] Other than infection, sleep medicine, nerve medicine, stomach or bowel issues, fever, pain, flu, cold or allergic rhinitis, appetite stimulant supplement or tonic. [b] Other than hypertension, diabetes, heart disease, high cholesterol, history of stroke, chronic lung disease, arthritis, arthrosis or rheumatism, depression. † Variation coefficient > 0.3: data should be interpreted with caution.

Source: National Survey on Access, Use and Promotion of Rational Use of Medicines in Brazil (PNAUM), 2014.

be seen that the effect is strongly influenced by the variable "presence of chronic diseases" in the model.

The top economic class (A/B) showed the highest prevalence of vitamin and/or mineral use. A negative confounding was found between outcome and economic classification, since after the adjustment, the CR increases, mainly in the A/B class. This effect may be due to the fact that these products are primarily purchased in cash. However, Bertoldi et al.[29] identified the same pattern, i.e., the highest prevalence in the top economic class, when they analyzed the global use of medications using PNAUM. International studies on vitamin and mineral use also found the same association: a higher prevalence of use in classes with a higher purchasing power[22,25].

Self-perceived health was included in the model to try to understand the subjective dimension of human health and to understand health as a complex and multifactorial condition[30]. Respondents who perceived their health as very good/good had the lowest prevalence of vitamin and/or mineral use. Other studies have found that users of dietary supplements were more likely to describe their health as very good[24], a fact our study did not confirm.

Analysis of regional distribution showed that the Northeastern region had the highest prevalence of vitamin and/or mineral use, followed by the Southeastern region. PNAUM data have already shown that the Northeastern region - together with the Midwestern region - had the highest prevalence rates of medication use for occasional illnesses[29]. Our study found that the Southern region had one of the lowest prevalence, second only to the Northern region. In the adjusted analysis, the factor "residing in the Southern region" was associated with a lower chance of using vitamins and/or minerals. To analyze this effect, the period of the research, i.e., the months of spring and summer, need to be related. Thus, flu and cold prevention remedies, such as vitamin C[31], may have been underestimated.

Parameters of products containing vitamins and/or minerals are established by the current legislation, which allows to distinguish between vitamin and/or mineral food supplements and remedies based on vitamins and minerals. Vitamin and/or mineral food supplements need to show an established usage limit that is defined according to the population group they are aimed at[32,33]. Products containing vitamins and/or minerals with therapeutic indications are considered remedies and need to be registered at the agency in charge[34]. Other countries define supplements and drugs based on vitamins and/or minerals according to different limits than those applied in Brazil[35], which makes it difficult to compare their use.

Approximately half of the vitamin and/or mineral users of the present study were taking multivitamins and multiminerals, as well as products containing calcium and vitamin D. Studies assessing prevalence of vitamin and/or mineral-based products using NHANES data also found higher prevalence rates of multivitamin and multimineral use[11,24,36], followed by products containing calcium[24]. In a study that proposed a consensus panel on multivitamin and multimineral use, it was pointed out that there are no published criteria that quantify the doses of micronutrients that should be included in multivitamins and multiminerals and that multiple definitions have been proposed[37]. However, there was a consensus that using multivitamins and multiminerals may result in health benefits in certain healthy subpopulations, such as pregnant women and the elderly, as well as in individuals with nutritional inadequacies[37,38]. However, there is no evidence to support their use in chronic diseases and cancer.

In the present study, use of calcium and associations was higher in people with chronic diseases, who use it mainly to treat joint diseases. Evidences on the use of calcium and vitamin D show that its consumption by people residing in the community who do not present risk factors related to the deficiency of these micronutrients seems to be inadequate[39-41].

There is a concern about excessive use of micronutrients by healthy people who do not present any nutritional deficiencies[42] and the use of these products for purposes that are not backed by scientific evidence found in clinical studies[43]. The literature describes that most of these products are used for personal reasons rather than on medical advice[24]. Despite being exempt from medical prescription, they should be administered under the supervision of a legally qualified health professional, since they have the potential to increase the bioavailability of micronutrients in the body. When used indiscriminately, they may increase micronutrient levels above tolerated limits[7]. Liver damage, joint pain, skin peeling, alopecia, headaches and vomiting related to excessive use of micronutrients, especially fat-soluble vitamins, have been described[44].

Prevalence rates and factors associated with vitamin and/or mineral use found by the present

study were calculated using a probabilistic sample of national representativeness in urban areas of the five geographic regions of Brazil. This feature allowed us to outline a national overview, filling a gap in knowledge about prevalence rates and factors associated with the use of these products. However, the present study has limitations as well. Some depend on its method, such as the impossibility of establishing a causal relationship. Others are seasonal, i.e., data were collected in the spring and summer months so that some products that would typically be intended for the prevention and treatment of the most prevalent disorders in cold months, such as vitamin C[31] to prevent colds and flu, may have been underestimated. Surveys on occasional use of medication are more efficient when covering the shortest possible recall period[45,46]. PNAUM's recall period for acute/occasional health situations was 15 days. This fact should be considered when comparing our own prevalence rates with those of other studies that applied different recall periods. The present study used the logistic regression technique to analyze the associated factors and results were expressed as odds ratios. Given that the outcome under study is uncommon, i.e., usually less than 10%, the OR is considered a good approximation of the prevalence ratio[47], a measure of association commonly used in this type of study.

To conclude, the present study showed that prevalence of vitamin and/or mineral use in the adult and elderly population living in urban areas in Brazil is higher in women, increases with age and is higher in subjects with a higher purchasing power. Multivitamins and multiminerals showed the highest frequency of use among users, which corroborates the results of some international studies. Given the higher prevalence observed in elderly women, we suggest that actions to promote the rational use of these products should aim this kind of public first. Rational use is understood as that which meets clinical needs and for an adequate period of time. Finally, our findings are the first ones that point to factors associated with the use of these products in the Brazilian adult and elderly population in general. We recommend that future national epidemiological surveys maintain and expand the observation of these products in the Brazilian population so as to allow to establish comparisons and analyze trends over time.

Collaborations

The first author, CR Pavlak, contributed to the design and planning of the research, to the analyses, to the interpretation of the results and to the writing of the article. The second author, SS Mengue, contributed to the design and planning of the research, to the interpretation of the results and to the writing of the article.

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References

1. Bailey RL, West KP, Black RE. The epidemiology of global micronutrient deficiencies. *Ann Nutr Metab* 2015; 66(Suppl. 2):22-33.
2. Mousa A, Naqash A, Lim S. Macronutrient and micronutrient intake during pregnancy: an overview of recent evidence. *Nutrients* 2019; 11(2):E443.
3. Gernand AD, Schulze KJ, Stewart CP, West KP, Christian P. Micronutrient deficiencies in pregnancy worldwide: health effects and prevention. *Nat Rev Endocrinol* 2016; 12(5):274-289.
4. Tam E, Keats EC, Rind F, Das JK, Bhutta AZA. Micronutrient supplementation and fortification interventions on health and development outcomes among children under-five in low- and middle-income countries: a systematic review and meta-analysis. *Nutrients* 2020; 12(2):E289.
5. Ahmed T, Haboubi N. Assessment and management of nutrition in older people and its importance to health. *Clin Interv Aging* 2010; 5:207-216.
6. Rautiainen S, Manson JE, Lichtenstein AH, Sesso HD. Dietary supplements and disease prevention – a global overview. *Nat Rev Endocrinol* 2016; 12(7):407-420.
7. Marra MV, Bailey RL. Position of the Academy of Nutrition and Dietetics: micronutrient supplementation. *J Acad Nutr Diet* 2018; 118(11):2162-2173.
8. Binkley N, Wiebe D. Clinical controversies in vitamin D: 25(OH)D measurement, target concentration, and supplementation. *J Clin Densitom* 2013; 16(4):402-408.
9. Giustina A, Adler RA, Binkley N, Bollerslev J, Bouillon R, Dawson-Hughes B, Ebeling PR, Feldman D, Formenti AM, Lazaretti-Castro M, Marcocci C, Rizzoli R, Sempos CT, Bilezikian JP. Consensus statement from 2nd International Conference on Controversies in Vitamin D. *Rev Endocr Metab Disord* 2020; 21(1):89-116.
10. Lichtenstein A, Ferreira-Júnior M, Sales MM, Aguiar FB, Fonseca LAM, Sumita NM, Duarte AJS. Vitamina D: ações extraósseas e uso racional. *Rev Assoc Med Bras* 2013; 59(5):495-506.
11. Kantor ED, Rehm CD, Du M, White E, Giovannucci EL. Trends in dietary supplement use among US adults from 1999-2012. *JAMA* 2016; 316(14):1464-1474.
12. Keshavarz P, Shafiee M, Islam N, Whiting SJ, Vatanparast H. Prevalence of vitamin-mineral supplement use and associated factors among Canadians: results from the 2015 Canadian Community Health Survey. *Appl Physiol Nutr Metab* 2021; 46(11):1370-1377.
13. O'Brien SK, Malacova E, Sherriff JL, Black LJ. The prevalence and predictors of dietary supplement use in the Australian population. *Nutrients* 2017; 9(10):E1154.
14. Gong W, Liu A, Yao Y, Ma Y, Ding C, Song C, Yuan F, Zhang Y, Feng G, Chen Z, Ding G. Nutrient supplement use among the Chinese population: a cross-sectional study of the 2010-2012 China Nutrition and Health Surveillance. *Nutrients* 2018; 10(11):E1733.
15. Fayh APT, Silva CV, Jesus FRD, Costa GK. Consumo de suplementos nutricionais por frequentadores de academias da cidade de Porto Alegre. *Rev Bras Cienc Esporte* 2013; 35(1):27-37.
16. Santos KMO, Barros Filho AA. Consumo de produtos vitamínicos entre universitários de São Paulo, SP. *Rev Saude Publica* 2002; 36(2):250-253.
17. Brunacio KH, Verly-Jr E, Cesar CLG, Fisberg RM, Marchioni DM. Uso de suplementos dietéticos entre residentes do Município de São Paulo, Brasil. *Cad Saude Publica* 2013; 29(7):1467-1472.
18. Sousa AG, Costa THM. Diet and supplement assessment in a Brazilian urban population. *Rev Saude Publica* 2021; 55:26.
19. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa Nacional de Saúde 2013: ciclos da vida*. Rio de Janeiro: IBGE; 2015.
20. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa Nacional de Saúde 2019: ciclos da vida*. Rio de Janeiro: IBGE; 2021.

21. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa de Orçamentos Familiares 2017-2018: análise do consumo alimentar pessoal no Brasil* [Internet]. 2020. [acessado 2022 set 17]. Disponível em: https://biblioteca.ibge.gov.br/visualizacao/livros/liv101742.pdf
22. Guo X, Willows N, Kuhle S, Jhangri G, Veugelers PJ. Use of vitamin and mineral supplements among Canadian adults. *Can J Public Health* 2009; 100(5):357-360.
23. Vatanparast H, Adolphe JL, Whiting SJ. Socio-economic status and vitamin/mineral supplement use in Canada. *Health Rep* 2010; 21(4):19-25.
24. Bailey RL, Gahche JJ, Miller PE, Thomas PR, Dwyer JT. Why US adults use dietary supplements. *JAMA Intern Med* 2013;173(5):355-361.
25. Cowan AE, Jun S, Gahche JJ, Tooze JA, Dwyer JT, Eicher-Miller HA, Bhadra A, Guenther PM, Potischman N, Dodd KW, Bailey RL. Dietary supplement use differs by socioeconomic and health-related characteristics among U.S. adults, NHANES 2011-2014. *Nutrients* 2018; 10(8):1114.
26. Kang M, Kim DW, Baek YJ, Moon SH, Jung HJ, Song YJ, Paik H-Y. Dietary supplement use and its effect on nutrient intake in Korean adult population in the Korea National Health and Nutrition Examination Survey IV (2007-2009) data. *Eur J Clin Nutr* 2014; 68(7):804-810.
27. Mengue SS, Bertoldi AD, Boing AC, Tavares NUL, Pizzol TSD, Oliveira MA, Arrais PS, Ramos LR, Farias MR, Luiza VL, Bernal RT, Barros AJ. National Survey on Access, Use and Promotion of Rational Use of Medicines (PNAUM): household survey component methods. *Rev Saude Publica* 2016; 50(Suppl. 2):4s.
28. Pocobelli G, Peters U, Kristal AR, White E. Use of supplements of multivitamins, vitamin C, and vitamin E in relation to mortality. *Am J Epidemiol* 2009; 170(4):472-483.
29. Bertoldi AD, Pizzol TSD, Ramos LR, Mengue SS, Luiza VL, Tavares NU, Farias MR, Oliveira MA, Arrais PS. Sociodemographic profile of medicines users in Brazil: results from the 2014 PNAUM survey. *Rev Saude Publica* 2016; 50(Suppl. 2):5s.
30. Reichert FF, Loch MR, Capilheira MF. Autopercepção de saúde em adolescentes, adultos e idosos. *Cien Saude Colet* 2012; 17(12):3353-3362.
31. Hemilä H, Chalker E. Vitamin C for preventing and treating the common cold. *Cochrane Database Syst Rev* 2013; 1:CD000980.
32. Agência Nacional de Vigilância Sanitária (Anvisa). Resolução da Diretoria Colegiada nº 243, de 26 de julho de 2018. Dispõe sobre os requisitos sanitários dos suplementos alimentares. *Diário Oficial da União*; 27 jul.
33. Agência Nacional de Vigilância Sanitária (Anvisa). Instrução Normativa nº 28, de 26 de julho de 2018. Estabelece as listas de constituintes, de limites de uso, de alegações e de rotulagem complementar dos suplementos alimentares. *Diário Oficial da União*; 27 jul.
34. Agência Nacional de Vigilância Sanitária (Anvisa). Resolução da Diretoria Colegiada nº 242, de 26 de julho de 2018. Altera a Resolução junho de 2011, a RDC nº 24, de 14 de Resolução RDC nº 107, de 5 de setembro de 2016, a Instrução Normativa – IN nº 11, de 29 de setembro de 2016 e a Resolução RDC nº 71, de 22 de dezembro de 2009 e regulamenta o registro de vitaminas, minerais, aminoácidos e proteínas de uso oral, classificados como medicamentos específicos. *Diário Oficial da União*; 27 jul.
35. Abe-Matsumoto LT, Sampaio GR, Bastos DHM. Suplementos vitamínicos e/ou minerais: regulamentação, consumo e implicações à saúde. *Cad Saude Publica* 2015; 31(7):1371-1380.
36. Rock CL. Multivitamin-multimineral supplements: who uses them? *Am J Clin Nutr* 2007; 85(1):277S-279S.
37. Blumberg JB, Cena H, Barr SI, Biesalski HK, Dagach RU, Delaney B, Frei B, Moreno González MI, Hwalla N, Lategan-Potgieter R, McNulty H, van der Pols JC, Winichagoon P, Li D. The use of multivitamin/multimineral supplements: a modified Delphi Consensus Panel Report. *Clin Ther* 2018; 40(4):640-657.
38. Biesalski HK, Tinz J. Multivitamin/mineral supplements: rationale and safety – a systematic review. *Nutr Burbank Los Angel Cty Calif* 2017; 33:76-82.
39. Bolland MJ, Leung W, Tai V, Bastin S, Gamble GD, Grey A, Reid IR. Calcium intake and risk of fracture: systematic review. *BMJ* 2015; 351:h4580.
40. Reid IR, Bolland MJ, Grey A. Effects of vitamin D supplements on bone mineral density: a systematic review and meta-analysis. *Lancet* 2014; 383(9912):146-155.
41. Reid IR, Bolland MJ. Calcium and/or vitamin D supplementation for the prevention of fragility fractures: who needs it? *Nutrients* 2020; 12(4):E1011.
42. Zhang FF, Barr SI, McNulty H, Li D, Blumberg JB. Health effects of vitamin and mineral supplements. *BMJ* 2020; 369:m2511.
43. Guallar E, Stranges S, Mulrow C, Appel LJ, Miller ER. Enough is enough: Stop wasting money on vitamin and mineral supplements. *Ann Intern Med* 2013; 159(12):850-851.
44. World Health Organization. *Vitamin and mineral requirements in human nutrition*. Geneva: WHO; 2004.
45. Moraes CG, Mengue SS, Pizzol T SD. Agreement between different recall periods in drug utilization studies. *Rev Bras Epidemiol* 2017; 20(2):324-334.
46. Lewis JD, Strom BL, Kimmel SE, Farrar J, Metz DC, Brensinger C, Nessel L, Localio AR. Predictors of recall of over-the-counter and prescription non-steroidal anti-inflammatory drug exposure. *Pharmacoepidemiol Drug Saf* 2006; 15(1):39-45.
47. Camey SA, Torman VBL, Hirakata VN, Cortes RX, Vigo A. Bias of using odds ratio estimates in multinomial logistic regressions to estimate relative risk or prevalence ratio and alternatives. *Cad Saude Publica* 2014; 30(1):21-29.

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