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DIETARY IODINE AND SELENIUM INTAKE BY PARTICIPANTS OLDER PEOPLE AT THE UNIVERSITY OF THE THIRD AGE

INGESTÃO ALIMENTAR DE IODO E SELÊNIO EM PARTICIPANTES DA UNIVERSIDADE DA TERCEIRA IDADE

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ABSTRACT

This study aimed to evaluate the dietary intake profile of iodine and selenium in participants of the University of the Third Age (UNATI). This cross-sectional study estimated dietary intake using a food frequency questionnaire administered to 30 participants. The mean age was 67.6 years, the majority were women (90%), and 83.3% were older than 60 years. The mean iodine intake was estimated to be 198.9 ± 50.8 µg/day, and selenium intake was 369.9 ± 145.3 µg/day, both above the recommended dietary intakes. Two categories were created based on the median (50th percentile), one category ≤ 68 years and the other > 68 years. The mean intake between the two categories was not significantly different for iodine (p=0.467) and selenium (p=0.146). The category > 68 years consumed more dairy products (p=0.045) and vegetables (p=0.039) than the younger category. Daily intake of iodine and selenium showed no correlation with each other (r=0.134; p=0.480) or with age (iodine: r=-0.199; p=0.289; selenium: r=0.150; p=0.429). Total iodine intake was positively correlated with salt (p<0.001), dairy products (p=0.016), and vegetables (p=0.018). Selenium intake was positively associated with eggs, meat, and fish (p<0.001) and nuts and legumes (p<0.001). Iodine intake was adequate for almost the entire group, with no excess consumption. No deficiency was observed concerning selenium intake, and intake was either sufficient or excessive without posing a disease risk.

Keywords: Food intake; Deficiency Diseases; Trace Elements; Elderly Health.

RESUMO

Objetivou-se levantar o perfil da ingestão alimentar de iodo e selênio em participantes da Universidade da Terceira Idade (UNATI). Neste estudo transversal a ingestão alimentar foi estimada usando por um questionário de frequência alimentar aplicado para 30 participantes. A média de idade foi de 67,6 anos, a maioria eram mulheres (90%), sendo que 83,3% tinham idade > 60 anos. A média de ingestão de iodo foi estimada em 198,9 ± 50,8 µg/dia e selênio em de 369,9 ± 145,3 µg/dia, ambas, acima da recomendação dietética. Foram criadas duas categorias segundo a mediana (percentil 50), uma categoria ≤ 68 anos e a outra > 68 anos. O consumo médio entre as duas categorias não foi diferente para iodo (p=0,467) e selênio (p=0,146), A categoria > 68 anos consumiu mais vezes produtos lácteos (p=0,045) e hortaliças e

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legumes (p= 0,039) que a categoria de menor idade. A ingestão diária de iodo e selênio não apresentou correlação entre si (r= 0,134; p=0,480) ou com a idade (iodo; r = -0,199; p=0,289; selênio; r = 0,150; p=0,429). A ingestão total de iodo teve correlação positiva com o sal (p<0,001), produtos lácteos (p=0,016) e hortaliças e legumes (p= 0,018). A ingestão de selênio teve correlação positiva com ovos, carnes e peixes (p<0,001) e oleaginosas e leguminosas (p<0,001). A ingestão de iodo foi adequada para quase a totalidade do grupo, não havendo consumo em excesso. Não observamos situações de carência para ingestão de selênio, estando adequada ou excessiva, porém, sem oferecer risco de doença.

Palavras-chave: *Consumo Alimentar; Deficiência Nutricional Oligoelementos; Saúde do Idoso.*

INTRODUCTION

The Open University of the Third Age (UNATI) was founded throughout Brazil in the 1970s. It is a multidisciplinary university extension program that engages in outreach, teaching, and research activities related to issues of the aging process as well as the appreciation of older adults in society and their inclusion in the university environment. The UNATI aims to provide a learning environment, exchange of experiences, intergenerational integration, knowledge sharing, and social relationships (ARAÚJO *et al*., 2020).

Both young and older people attend the UNATI. Many educational program activities for older people in Brazil have also included subgroups of individuals under 60 years of age. This is due to the significant number of retired individuals who still exist at a younger age (SABATINI *et al*., 2012). Thus, UNATI play an important role in helping them to restructure their lives and understand the aging process. It offers programs that emphasize intellectual, social, and physical activities for this population, mainly older adults. Investing in knowledge for a better quality of life is a priority, intending to reduce the need for institutionalization (COSTA, *et al*., 2016).

Aging is characterized by an increased risk of cognitive decline and physiological changes, increasing the risk of morbidity and mortality due to changes in nutritional priorities. Nutrient balance through diet becomes challenging for older individuals and more complicated with advancing age. This increases the risk of malnutrition, often associated with social isolation, psychosocial problems, cumulative effects of polypharmacy, cognitive decline, changes in taste and appetite, and loss of muscle mass and function (sarcopenia). These factors become critical to the overall health status of older adults (GRAMMATIKOPOULOU *et al*., 2019). These age-related conditions delay the attainment of health benefits, making diet quality an essential factor to be explored for disease prevention and the promotion, maintenance, and restoration of health in older adults, mitigating various age-related changes to improve quality of life (ARAÚJO *et al*., 2020).

An inadequate diet, especially one deficient in essential micronutrients, can have serious long-term consequences, especially endocrine changes. Minerals play an inherent role in healthy aging due to their diverse functions in biological processes, with particular emphasis on the trace elements most associated with longevity, such as calcium, copper, magnesium, selenium, iodine, and zinc (ALIS *et al*., 2016).

Dietary iodine deficiency is a public health problem in many countries, especially in vulnerable groups such as older people (DESTEFANI *et al*., 2015). Iodine is an important micronutrient at all stages of life and is essential for thyroid hormone synthesis, brain development, and central nervous system function (MEZZOMO; NADAL, 2016; REIS *et al*., 2021). Dietary iodine intake by older people is a determining factor in the most common thyroid disorders during this phase of life. Insufficient iodine intake, even mild or moderate, is associated with goiter and thyroid hyperfunction, while relatively high intake is associated with thyroid dysfunction. In older individuals, thyroid dysfunction may have a more clinically significant impact than in young adults, with hyperthyroidism associated with a higher risk of atrial fibrillation, embolism, and osteoporosis. In contrast, hypothyroidism is associated with dyslipidemia and atherosclerosis (WATUTANTRIGE-FERNANDO, 2016). Iodine can be found in various foods, with notable sources including seafood, iodine-rich dairy products (from animals raised on iodine-rich soils or fed with this micronutrient), and iodine-fortified table salt in many countries. The synthesis and proper functioning of thyroid hormones depend on micronutrients such as iodine, selenium, and zinc (MEZZOMO; NADAL, 2016).

Selenium is a trace element involved in several functions in the body. It participates in redox and antioxidant reactions as part of a group of enzymes called selenoproteins. These selenoproteins play a role in thyroid hormone metabolism, immune system, and reproductive functions (LI *et al*., 2020). Selenium plays an essential role in the prevention of age-related diseases such as neuropsychiatric disorders, cardiovascular disease, infections, and cancer. It also helps reduce inflammation and skin aging. Selenium helps minimize the damage caused by reactive oxygen species (ROS) to cellular components, thereby combating cellular senescence. Consumption of selenium-rich foods has been associated with increased longevity. Centenarians have high plasma levels of selenium and iron, which are associated with lower mortality rates. However, it has been observed that selenium levels are significantly reduced in older individuals, indicating a dietary deficiency. It is also important to note that excess selenium in the body can lead to tooth loss, hair and nail problems, and nervous system disorders (CAI *et al*., 2019). Meat, seafood, fish, black beans, and whole wheat flour are excellent sources of selenium. In addition, Brazil nuts are plentiful sources of selenium, with a single nut providing approximately 160% of the recommended daily intake (PADOVANI *et al*., 2006).

Considering that the majority of participants in UNATI are older people, with few retired adults under the age of 60 (SABATINI *et al*., 2012), it is necessary to examine their health profiles to identify nutritional risks, including deficiencies or excesses. Studies measuring urinary iodine excretion have reported that people over 65 years are more iodine deficient than adults and young people, especially women (WATUTANTRIGE-FERNANDO, 2016). The assessment of dietary intake, nutritional interventions, and healthy eating habits contribute to the improvement of quality of life

(ARAÚJO *et al*., 2020). Therefore, the main objective of this study was to assess the consumption of the micronutrients iodine and selenium using a food frequency questionnaire (FFQ) and to estimate their average daily intake in a group of UNATI participants at the State University of Western Paraná (UNIOESTE), Francisco Beltrão Campus, State of Paraná, Brazil. In addition, the study aimed to assess the average weekly consumption frequency of the food groups included in the FFQ.

METHODOLOGY

This is a descriptive, cross-sectional, quantitative observational study. Several methods can assess daily food consumption, including food frequency questionnaire (FFQ), 24-hour dietary recall (R24h), food records or diaries, dietary history, and inventory methods. Among these, the FFQ is informative, practical, and has fewer limitations. It combines the positive characteristics of the other methods, which is why it is commonly used in nutritional epidemiologic studies (PEDRAZA; MENEZES, DE, 2015). Thus, the FFQ was chosen for nutritional assessment in the present study.

Due to the suspension of classes at the host university of the UNATI program in the first semester of 2020 due to the COVID-19 pandemic, individual online interviews were conducted with the participants using a specific application designed for this purpose. The calls were made during May and June 2020. Inclusion criteria for participation in the study included being 50 years or older and enrolled in UNATI. Enrollment in this program is open to individuals 50 or older, provided they are available to participate in the activities, which explains the presence of retirees under the age of 60. Therefore, there was no exclusivity for older individuals, as defined by the Statute of the Elderly, which only considers those aged 60 years and above (BRASIL, 2022). In addition, to be included in this study, individuals had to agree to participate after receiving the necessary information from the researchers and signing the informed consent form. The study did not include individuals who had difficulty communicating online or could not participate due to illness, lack of electronic devices, or lack of consent.

A 53-item FFQ was used to assess the dietary frequency of iodine and selenium intake by UNATI students. These items were categorized into eight food groups: dairy products, eggs, meat and fish, oils and fats, bread, cereals and similar products, vegetables and legumes, legumes and nuts, fruits, and beverages. Table salt was considered separately from the food groups. The FFQ was adapted from the studies by GLABSKA *et al.* (2017) and RIBEIRO *et al.* (2017) to include the primary food sources of iodine and selenium as well as typical Brazilian and regional foods that met these criteria. To obtain the nutritional information of the foods in the FFQ, food composition tables from the United States Department of Agriculture (USDA - https://fdc.nal.usda.gov) and the study by GLABSKA *et al.* (2017) were consulted. The frequency of food consumption was classified as daily, weekly, monthly, or never/rarely. After collecting the information, the data were converted into individual weekly frequencies for comparison. The personal information on the reported frequency of consumption for each item was entered into the Dietbox® nutrition software to estimate food consumption, and iodine and selenium intakes were expressed in micrograms (µg) per day. The intakes of these micronutrients were estimated and compared with the estimated dietary requirements for an individual or population, also known as the Recommended Dietary Allowance (RDA), which is the recommended daily intake for maintaining good health (PADOVANI *et al.*, 2006). To determine whether the daily intake was excessive, the values were compared with the highest daily intake that appears to pose no risk of adverse health effects for almost all individuals at a given stage of life, known as the Tolerable Upper Intake Level (UL). Therefore, we used the RDA values for iodine (55 µg/day) and selenium (150 µg/day) as well as the UL values for iodine (1100 µg/day) and selenium (400 µg/day) as references (PADOVANI *et al.*, 2006).

Participants were invited to participate in this study online. After receiving detailed information about the procedures and having their questions answered, they were provided with a PDF file containing the Informed Consent Form (ICF) for this study. Once signed, the form was photographed and returned to the researchers. This study was conducted per the ethical principles of Resolution No. 466/2012 of the National Health Council of the Ministry of Health (Brazil). It was approved by the Human Research Ethics Committee of UNIOESTE under protocol number 2.748.216 (CAAE 91397118.0.0000.0107).

The statistical analysis of this study included descriptive analysis, and Student's t-test was used to compare the mean estimated intakes of iodine and selenium and the weekly frequency of consumption among food groups. The results of this study are presented as mean ± standard deviation or relative frequency (%). Consumption of food groups was expressed as weekly frequency (number of times/week). Considering the age range (50 to 80 years), the participants were divided into two categories based on the median age (50th percentile): participants ≤ 68.5 years (below or equal to the median) and participants > 68.5 years (above the median). The two categories were compared using Student's t-test for continuous variables and Fisher's exact test for comparisons between proportions. Pearson's correlation test (r) was used for correlational analyses. The strength of correlation was classified as follows: r = 0.10 to 0.30 (weak), r = 0.40 to 0.60 (moderate), and r = 0.70 to 1 (strong) (DANCEY; REIDY, 2007). Analyses were performed with SPSS software, version 23 (Statistical Package for the Social Sciences, Inc., Chicago, USA). Statistical significance was set at $p < 0.05$, with a maximum significance level of 5%.

RESULTS

The UNATI program at UNIOESTE, Francisco Beltrão Campus, has 49 enrolled and active students who have access to the Internet. All of them were invited to participate in the study. Among them, 61.2% (30) agreed to participate, 12.3% (6) did not respond after being contacted, and 26.5% (13) refused to participate for personal reasons. Of the 30 participants, 90% (27) were women, and only 10% (3) of the men agreed to participate. The mean age of the participants was 67.6 ± 7.5 years. A small part of the group, 16.7% (5), had an age equal to or less than 60 years. In contrast, the majority, 83.3% (25) of the participating students, were older adults, according to the current Brazilian Statute for Older Adults (BRASIL, 2022).

When evaluating the food groups consumed by the participants, it was possible to estimate the mean iodine intake, which was 198.9 ± 50.8 µg/day and was found to be above the recommended RDA for adults (PADOVANI *et al*., 2006). On the other hand, the estimated mean selenium intake of the participants was 369.9 ± 145.3 µg/day, which was also significantly higher than the RDA for adults. However, this value remained below the tolerable upper intake level (UL) for selenium (PADOVANI *et al*., 2006).

The estimated quantitative pattern of iodine and selenium food intake by the participants, according to the weekly consumption of each food group, was calculated using the FFQ and presented in terms of the average amount ingested in micrograms (µg) per week (Table 1).

Table 1 - Average weekly intake of iodine and selenium by the participants of the University of the Third Age at UNIOESTE in Francisco Beltrão, Paraná, concerning the food groups consumed, 2020.

Average weekly iodine and selenium intake		
Food group	***Selenium amount (µg)/week (mean and standard deviation)***	***Iodine amount (µg)/week (mean and standard deviation)***
Dairy Products	102.8 ± 80.1	90.0 ± 74.9
Eggs, meat, and fish	1810.0 ± 1824.9	48,23 ± 52.28
Oils and fats	0.3 ± 0.2	4.5 ± 3.8
Bread, cereals, and similar	60.2 ± 50.6	13.7 ± 7.8
Vegetables and legumes	16.1 ± 9.6	119.4 ± 76.6
Pulses and oilseeds	575.5 ± 560.4	62.2 ± 61.0
Fruit and natural juices	19.9 ± 9.2	40.7 ± 8.4
Beverages and gelatin	0.3 ± 0.6	51.2 ± 6.4
Salt	1.3 ± 0.4	962.6 ± 46.6
Total	2586.0 ± 2526.8	1392.2 ± 337.7

Source: Authors

Table 2 shows the average daily intake profile of iodine and selenium for each age category according to the median. There was no significant difference between the two categories in the average daily intake of iodine and selenium or the percentage of participants with selenium intake above the Tolerable Upper Intake (UL). There was also no significant difference between the categories in the rate of participants with estimated intakes that met the recommended requirements (>150 and <400 µg/day). Among all participants, 30% (9) had an adequate selenium intake (>150 and <400 µg/day), while the others exceeded the UL. No individual was found to have a selenium intake below the Recommended Dietary Allowance (RDA).

As regards estimated iodine intake, 6.7% (2) participants had an intake below the RDA. There were no individuals who exceeded the UL for this micronutrient. Therefore, it was impossible to compare the age categories concerning the percentage of intake according to RDA and UL.

A significant difference was observed between the categories when considering the average weekly frequency of food group consumption, indicating that the older group consumed dairy products and vegetables more frequently (Table 2). These food groups were the primary sources of iodine for the participants, second only to salt, which was the primary source (Table 1).

Table 2 - Profile of Iodine and Selenium Consumption and Frequency of Food Group Consumption among Age Categories of Participants of the University of the Third Age (UNATI) at UNIOESTE in Francisco Beltrão, Paraná, Brazil, 2020.

Consumption profile	Participants (n=15)	Participants (n=15)	p-value	RDA
Average daily consumption	*Age ≤ 68 years*	*Age > 68 years*		
n	15	15		Iodine *(µg/day)*
Iodine (µg/day)	191.5±52,1	205.3±50.3	0.467	55
				Selenium *(µg/day)*
Selenium (µg/day)	330.3±142.1	407.9±142.4	0.146	150
				UL
				Iodine (µg/day)
				1100
	80% (12)	60% (9)	0.427#	Selenium (µg/day)
% (n) of participants consuming Selenium above UL	20% (3)	40% (6)		400
% (n) of participants consuming Selenium between 150 and 400 µg/day				
	Age ≤ 68 years	*Age > 68 years*		
Average weekly frequency of consumption				
	10.3±6.7	16.3±8.9*	**0.045**	
Dairy products	13.6±4.7	13.9±2.7	0.796	
Eggs, meat, and fish	13.6±3.2	16.2±3.8	0.053	
Oils and fats	14.0±4.9	15.6±5.2	0.407	
Breads, cereals, and similar	19.8±6.0	24.2±4.9*	**0.039**	
Vegetables and legumes	9.6±4.2	11.7±5.6	0.256	
Pulses and oilseeds	22.3±3.3	22.6±2.3	0.802	
Fruit and natural juices	11.6±4.3	13.0±2.4	0.287	
Beverages and gelatin	8.4±2.9	8.4±2.9	1.000	

* Indicates significant difference by Student's t-test ($p<0.05$)
# Indicates p-value by Fisher's exact test.
RDA - Daily nutritional intake requirement; UL - Tolerable upper limit of the highest intake.
Source: Authors.

Using Pearson's test and correlation, we did not find a statistically significant correlation ($r = 0.134$; $p = 0.480$) between daily selenium intake and iodine intake. The analyses in Table 3 show the correlations between the food groups and their respective amounts of iodine and selenium consumed with the total daily intake of iodine and selenium. Total iodine intake was observed to have a strong positive correlation with salt, a moderate correlation with dairy products, and a moderate correlation with the vegetables and legumes group. On the other hand, total selenium intake showed a strong positive correlation with the eggs, meat, and fish group and the nuts and legumes group. The correlation test also showed no significance for iodine intake (r = -0.199; p = 0.289) and selenium intake (r = 0.150; p = 0.429) with the age of the participants.

Table 3 - Correlation coefficients (r) between food group consumption and total daily intake of iodine and selenium according to the reported consumption by participants from the University of the Third Age at UNIOESTE, Francisco Beltrão Campus, Paraná, 2020.

Daily intake (µg/day)				
Food group (daily consumption)	***Iodine - Correlation coefficient (r)***	***p-value***	***Selenium - Correlation coefficient (r)***	***p-value***
	0.435*	**0.016**	0.335	0.069
Dairy products	0.116	0.540	0.893*	**<0.0001**
Eggs, meat, and fish	0.111	0.556	-0.013	0.945
Oils and fats	0.241	0.198	0.133	0.481
Breads, cereals, and similar	0.426*	**0.018**	0.192	0.309
Vegetables and legumes	0.089	0.637	0.706*	**<0.0001**
Pulses and oilseeds	0.0001	0.999	0.262	0.160
Fruit and natural juices	-0.041	0.829	0.082	0.665
Beverages and gelatin	0.928*	**<0.0001**	-0.083	0.662

* Indicates statistical significance by Pearson's correlation test.

Fonte: Authors.

Table 4 shows the average usual weekly consumption frequency of the food groups reported by the participants. Notably, the most commonly consumed food groups were fruits and fresh juices, vegetables, and legumes, followed by the beverages and gelatin groups.

Table 4. Average weekly consumption frequency of food groups among participants of the University of the Third Age at UNIOESTE, Francisco Beltrão Campus, Paraná, 2020.

Food group	*Average frequency of consumption per serving/week*
Dairy Products	13.3± 11.1
Eggs, meat, and fish	13.8± 11.0
Oils and fats	14.9± 12.6
Bread, cereals, and similar	14.8± 10.6
Vegetables and legumes	22.0± 11.4
Pulses and oilseeds	10.6± 9.7
Fruit and natural juices	22.5± 2.8
Beverages and gelatin	17.1± 8.6
Salt	8.4± 2.8

Source: Authors.

DISCUSSION

This study aimed to estimate the dietary intake of iodine and selenium based on the frequency of consumption of food groups, assessed by a food frequency questionnaire (FFQ), in a group of participants from the University of the Third Age. In this study, we observed that 30% and 93.3% of the participants consumed selenium and iodine, respectively, according to the Recommended Dietary Allowances (RDAs), without the use of supplements. Although a small proportion of the group (6.7%) had iodine intakes below the recommendations, there was no excess iodine consumption. In comparison, selenium intakes were excessive in 70% of the group, and no selenium deficiency was observed. The RDAs for nutrients should be used as intake targets. Values above the upper limit (UL) represent a risk of developing adverse effects. However, if habitual consumption is above the RDA, there is a greater likelihood that the dietary needs of both individuals and populations will be met (PADOVANI *et al.*, 2006).

This study reported that 90% of the participants were women. The average age of the entire group was 67 years, a characteristic of UNATI programs, meaning there is a predominance of older individuals. However, there was also a small presence of individuals under the age of 60. Therefore, in this study, we will discuss the results considering the majority of older participants. Their greater longevity can explain the predominance of women and represents one of the typical phenomena worldwide, known as the feminization of old age (SILVA *et al.*, 2019). The higher frequency of women, the variation in the age range, and the average age of the participants are similar to studies conducted in other UNATIs thorough Brazil (SABATINI *et al.*, 2012; COSTA *et al.*, 2016).

The daily intake of iodine and selenium in this study was correlated with the primary dietary sources of these trace elements, with a strong correlation observed between iodine and salt as the primary source and between selenium and the food group of eggs, meat, and fish. The category of participants over 68 years of age showed higher consumption of the primary sources of iodine. Still, no significant correlation was observed between age and the amount of iodine consumed.

In a cross-sectional study in the State of São Paulo involving 135 women with a mean age of 68 years, the authors reported a mean iodine intake of 101 μg/day. They identified a 42% iodine deficiency rate in the study population. The authors reported only two women with hyperthyroidism with an average intake of 154 μg/day, indicating an intake above the RDA. It is vital to identify inadequate intake in a vulnerable group such as older people to prevent disease or complications of chronic diseases in this population (DESTEFANI *et al.*, 2015).

A study conducted in a small community evaluated the iodine nutritional status of over 300 individuals by assessing iodized salt consumption and urinary iodine excretion (iodury). The study estimated a daily iodine intake of 196 μg/day for adults and 226 μg/day for older people, with approximately 18% of individuals having an insufficient intake and 6% having an excess intake (MAULER, 2020).

The consequences of iodine deficiency in adults and older people include toxic nodular goiter, impaired mental function, and reduced work productivity, all of which are symptoms associated with hypothyroidism. Other consequences of iodine deficiency include damage to the retina, skin, prostate, uterus, ovaries, stomach, cardiovascular disease, neuropathy, and disorders related to the immune system (ZIMMERMANN; BOELAERT, 2015). The consequences of inadequate dietary iodine represent a global public health issue with severe implications for human, social, and economic development levels, with food deficiency being the primary cause of this condition (REIS *et al*., 2021) selênio e iodo no controle do hipotireoidismo subclínico e suas descrições na literatura científica, que são detentoras de um grande potencial de inovação e ainda não foram exploradas em todas as suas potencialidades. Foi realizada uma revisão de literatura, no qual adota um processo replicável, científico e transparente, sendo recomendada para reunir e analisar os estudos relevantes sobre o tema. Cinco bases de dados científicas foram utilizadas na pesquisa, ScienceDirect Journals (Elsevier.

In our study, no participants were observed to consume excessive amounts of iodine. On the other hand, excessive iodine intake from dietary sources is rare and undesirable. Both excessive and deficient levels of iodine and selenium contribute to thyroid changes. These micronutrients play a critical role in the production and activation of thyroid hormones, such as thyroxine (T4) and triiodothyronine (T3) (MEZZOMO; NADAL, 2016). Excessive dietary iodine can lead to toxic symptoms, including diarrhea, nausea, and vomiting. In chronic cases, it can cause swelling of the airways, respiratory problems, cyanosis, and coma. Another consequence is the possible development of iodine-induced hyperthyroidism, which can cause heart damage and is a particular risk in the presence of underlying heart disease (LEUNG; BRAVERMAN, 2014).

Indeed, the participants in the present study consumed approximately 8.4 servings of salt per week (Table 4), equivalent to 137.5 µg/day (adapted from Table 1). According to the World Health Organization (WHO), the most cost-effective and efficient strategy recommended for iodine deficiency is to correct the deficiency by increasing iodine intake through food fortification. This is the case with iodine-fortified salt, implemented in several countries, including Brazil. However, even when salt fortification is mandatory, iodine intake often does not reach the expected level, and many people have inadequate iodine intake (WHO, 2004). It is estimated that the Brazilian population consumes approximately 9.6 g of salt per person per day, a value much higher than the WHO recommendation of 5 g/person/day, suggesting that iodine consumption in Brazil exceeds the RDA recommendation of 150 µg/day (DESTEFANI *et al*., 2015). This agrees with our results. The other good sources of iodine consumed by the participants in this study showed a moderate correlation and were dairy products and vegetables, respectively. Iodine intake varies in different regions of the country, and the primary food sources include iodized salt, seafood, milk, dairy products, eggs, and vegetables grown in iodine-rich soils as well as marine foods that concentrate iodine from seawater (WATUTANTRIGE-FERNANDO, 2016).

As previously reported, selenium intake in our study exceeded the RDA recommendations. Furthermore, the older participants consumed more selenium above the UL than the younger ones (≤ 68 years). Although the latter category had a mean intake that was adequate according to the RDA, 80% of them had an excess intake. In adults, the ELSA-Brasil study found a mean selenium intake of 222 µg/day, with a higher intake in women (TEIXEIRA *et al*., 2016). The National Dietary Survey from the Household Budget Survey (FBS) reported an average selenium intake of 107 µg/day in the population, with a higher intake in men (TURECK *et al*., 2013). These epidemiologic studies in Brazil show selenium intakes above the levels recommended by the RDA. Epidemiologic studies in some isolated communities have shown average selenium intakes ranging from 41 to 72 µg/day, indicating intakes closer to the levels recommended by the RDA. Selenium consumption in the Brazilian population ranges from 30 µg to 200 µg/day, varying among regions of the country, and deficiency occurs when consumption falls below 30 µg/day, ranging from deficit to excess (DIAS *et al*., 2021) in contrast to our study where the prevalence of excessive selenium intake was high.

In Brazil, a study carried out in São Paulo reported that selenium intake influences its plasmatic concentration. It was observed that lower serum concentrations resulted from reduced selenium intake due to its low content in the foods consumed in this Brazilian city (DONÁDIO *et al*., 2016). The dynamic balance between selenium intake and excretion maintains selenium levels in the human body. Low selenium levels are found in populations living in regions with low soil selenium content (VENTURA; MELO; CARRILHO, 2017). Selenium deficiency affects the regular synthesis of selenoproteins and the regulation of T3 and T4 hormone homeostasis (MEZZOMO; NADAL, 2016). The thyroid stands out as the organ with the highest concentration of selenium. Dietary selenium or supplementation prevents thyroid disorders (VENTURA; MELO; CARRILHO, 2017). The thyroid gland expresses a variety of selenoproteins involved in protection against oxidative stress and thyroid hormone metabolism. However, in selenium-deficient diets, the endocrine organs and the brain are preferentially supplied, especially by the thyroid, which efficiently retains this trace element. Reduced plasma selenium levels affect thyroid hormone levels, and elevated serum selenium levels are associated with a lower risk of developing subclinical hypothyroidism (ANDRADE *et al*., 2018). Excess selenium in the body can lead to a toxic effect called selenosis, with symptoms including gastrointestinal disorders, hair loss, neurological damage, nail peeling, tooth deterioration, and fatigue. It has also been linked to pulmonary edema, bronchitis, cancer, depression, liver bleeding, skin rash, eye irritation and tearing, vomiting, nausea, and diarrhea (MEZZOMO; NADAL, 2016; CAI *et al*., 2019).

Although a significant proportion of the participants in this study consumed selenium at levels above the Tolerable Upper Limit (UL), toxic effects would be unlikely because the lowest observed adverse effect level (LOAEL) is approximately 900 µg/day. Many individuals will likely remain free of harmful effects even at these intake levels. While intake above the UL indicates an increased risk, as long as it remains below the LOAEL, it is unlikely to result in clinical disease (MAIHARA *et al*., 2004). Daily selenium intake showed a strong positive correlation with the food groups of eggs, meat, fish, nuts, and legumes. It is important to note that daily selenium intake was unrelated to iodine intake or increasing age. In Brazil, staple foods such as beans, wheat flour, rice, cassava flour, and corn are not good sources of selenium, while animal-based and more expensive sources are better options (ANDRADE *et al*., 2018).

Although this study has limitations regarding the sample size and the use of an FFQ to collect and estimate the amounts of iodine and selenium consumed, it identifies significant findings within the studied group that can serve as a regional reference for future studies on the nutritional status of iodine and selenium. Therefore, considering the results, monitoring the nutritional status of iodine and selenium is suggested and essential, as part of the population is exposed to variations in their consumption, which may have avoidable health consequences.

CONCLUSIONS

This study allowed the characterization of iodine and selenium intake in a group of participants from the University of the Third Age (UNATI) in Francisco Beltrão, in the southwestern region of the State of Paraná. The iodine intake was found to be quite adequate for the daily requirement, while the selenium intake was excessive for the majority of the participants. Table salt was the primary source of iodine for the participants, and eggs, meat, and fish were the main sources of selenium. Iodine and selenium intakes were not correlated and did not vary with age. However, despite excessive selenium intake, the likelihood of toxic effects is very low. Therefore, based on the findings, it is suggested and essential to monitor the nutritional status of iodine and selenium, as part of the population is exposed to variations in the consumption of these trace elements, which may have preventable health consequences if appropriate dietary guidance is provided.

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