ORIGINAL ARTICLE

CHARACTERISTICS OF THE HIGH IODURIA CONCENTRATIONS IN SCHOOLCHILDREN AND ADOLESCENTS IN COLOMBIA

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ABSTRACT

Objetives. To determine the characteristics of high ioduria concentrations in schoolchildren and adolescents in Colombia. **Materials and methods**. Secondary analysis of the 2015 National Survey of the Nutritional Situation in Colombia in participants aged 5 to 17 years, which included the measurement of ioduria. The criteria to measure the nutritional status of iodine were based on the median urinary iodine concentration in µg / L defined by the World Health Organization (WHO), where values <100 are considered deficient, between 100-199 adequate, 200-299 above the requirements and> 300 excessive. Odds ratio measurements were also performed through logistic regression analysis. **Results**. The national median iodine for schoolchildren and adolescents was 406.8 µg / L and 410.8 µg / L respectively, higher in the urban area (410.5 µg / L), in the Atlantic region the highest level was found for schoolchildren (423.7 µg / L) and in the central for adolescents (427.7 µg / L). 4.4% of schoolchildren and 2.2% of adolescents presented deficiency and in more than 75% of the population, there was excessive intake of iodine. The factors associated with excessive iodine intake in schoolchildren were age, ethnicity, region and wealth index, and for adolescents gender and geographic area. **Conclusions**. The iodine concentrations in Colombian schoolchildren and adolescents are higher than adequate according to WHO, the deficiency is very low and a serious public health problem occurs due to excessive iodine intake in three-quarters of the population.

Keywords: Iodine in urine; Iodine deficiency; Excess iodine; Schoolchildren (Source: MeSH NLM).

INTRODUCTION

Iodine —a trace element found in soil, water and air— is an essential micronutrient for humans. In the human body, its main function is to regulate the production of thyroid hormones necessary for cell growth and development, especially for nerve cells (1).

Deficient iodine intake leads to clinical manifestations called iodine deficiency disorders (IDD). The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) recommend universal salt iodization as a safe, cost-effective and sustainable strategy to ensure sufficient iodine intake by the population (2).

In recent years, great progress has been made in the fight to eliminate iodine deficiency. In 1993, the WHO estimated that IDD affected 110 countries worldwide, while more recent studies estimate the number of countries with iodine deficiency at 30, located mainly in Europe and Africa, while Latin American countries, on the other hand, are at risk of excessive iodine intake (3).

In Colombia, salt iodization for human consumption has been established by law since 1947 and on April 29, 1988, Colombia was declared a "IDD-free" country (4); however, it is increasingly common to find iodine levels above the levels recommended by the WHO, which is now a new public health problem. This same entity refers that the target population for IDD surveillance is schoolchildren, pregnant women and children under two years of age. Schoolchildren between 5 and 17 years of age are considered a vulnerable population; in this

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regard, a higher prevalence of goiter has been reported in children between 8 and 10 years of age [5-6].

Ingesting high doses of iodine is associated with hypothyroidism in susceptible patients, including those with autoimmune thyroid disease, subacute thyroiditis, postpartum thyroiditis; and with hyperthyroidism in patients with risk factors including nontoxic or diffuse nodular goiter and latent Graves' disease [7]. In Colombia, specific studies have been carried out in places such as Popayán (n=139) where a median ioduria of 510.3 μg/L was found [8] and in Quindío (n=444) where severe deficiencies (rural areas) and excessive iodine intake (urban population) were found [9]. In 2002, a sentinel study showed that 85% of the national population had an excessive iodine intake [1] and recently in the Survey of the Nutritional Situation of Colombia 2015, the information on the nutritional status of iodine in the Colombian population was updated and the situation of iodine excess in Colombian schoolchildren and adolescent population was restated.

This study aims to describe the characteristics of elevated iodine concentrations in schoolchildren and adolescents in Colombia.

KEY MESSAGES

Motivation for the study: For two decades and until the 2015 National Survey of the Nutritional Situation in Colombia, no population studies had been conducted to account for ioduria concentrations in schoolchildren and adolescents.

Main findings: It is evidenced that less than 5% have deficiency and more than 75% have excessive iodine intake and that it is associated with some sociodemographic characteristics.

Implications: It is recommended to revise the salt fortification regulation to reduce ioduria levels to those suggested by WHO.

MATERIALS AND METHODS

Design and study population

The information from the schoolchildren and adolescents included in our sample was taken from the vitamins and minerals component of the National Survey of Nutritional Status (ENSIN) conducted in 2015, a cross-sectional household survey, with a probabilistic sample design, stratified in several stages by clusters, comprising 238 primary sampling units and 295 municipalities. This survey was conducted in 44,000 households; the population sample consisted of 22,704 schoolchildren and 14,106 adolescents, of which 16,151 schoolchildren and 6,388 adolescents were part of the subsample for ioduria determination [10].

Determination of ioduria

After filling out the informed consent form, each participant was given a container to collect 15 mL of urine at any time of the day. Later, 3 drops of hydrochloric acid were added to these 15 mL to avoid bacterial proliferation, the samples were initially refrigerated and subsequently frozen at -20 °C until they were processed in the nutrition laboratory of the Instituto Nacional de Salud (INS). The determination of iodine concentration in urine was carried out by spectrophotometry using ammonium persulfate, and the Sandell-Kolthoff reaction modified by Pino and collaborators [11].

The epidemiological criteria for measuring nutritional iodine status were based on the median urinary iodine concentration in μg/L as defined by WHO, which describes that values <100 are considered deficient, between 100-199 are considered as adequate iodine nutrition, 200-299 are above requirements and >300 represents an excessive iodine intake [12].

Variables

For the sociodemographic analysis, variables of age, sex, region, area, wealth index and ethnicity were analyzed. Colombia has six defined regions: Caribbean, Central, Eastern, Amazon and Orinoco, Pacific and Bogota; this distribution was used for our study. Regarding ethnicity, three were defined: the first is the Afro-descendant population, which includes Black, Mulatto, Afro-Colombian, Afro-descendant and Palanquero de San Basilio or Raizales; the second is the indigenous population and the third corresponds to the rest of the population, which in Colombia is called "without ethnic belonging", who are people who don't identify themselves as any of the above. The wealth index corresponds to a measure that ranks households according to socioeconomic status, it is more of a structural measure (it does not measure income or consumption) [10].

Statistical analysis

The level of iodine present in urine does not follow a normal distribution (Kolmogorov-Sminov test), therefore it was necessary to use the Mann-Whitney U test, also known as the Wilcoxon rank-sum test to determine whether the differences between the various subpopulations were statistically significant [13]. The other indicator we analyzed was the proportion of excessive iodine intake. To test the null hypothesis of equality between the proportions of two subpopulations (sociodemographic variables), we used a statistic test with a standard normal distribution, taking into account that the sample size is sufficiently large. In all cases a significance level of 5% was considered, seeking to have a high level of precision for each estimate [14]. The ioduria concentration is a continuous variable and what we intended to achieve with the estimation of the 25th, 50th and 75th percentiles was to have reference values to analyze the dispersion of the ioduria concentration. The values were calculated from the variable weighted by its corresponding expansion factor.

A logistic regression model was constructed to determine the contribution of sociodemographic variables to the probability of having an excessive iodine intake. This model was developed independently for the population group of schoolchildren and adolescents, and odds ratio (OR) values with 95% confidence intervals were obtained for each category of the independent variables. The reference categories of the variables were those with the highest prevalence [15]. In the adjusted model, the variables of age and sex were selected, taking into account that as schoolchildren and adolescents become older, they are more exposed to iodine-source foods and to the addition of salt to food. Likewise, regarding sex, findings in Colombia have shown that female schoolchildren and adolescents also show a tendency to better dietary practices compared to males [10].

Ethical considerations

The ethics and research committees of the Instituto Nacional de Salud endorsed this study. The Scientific, Technical and Administrative Norms for Health Research were taken into account, for a minimum risk study in human beings, as established in resolution 008430 of 1993, of the Ministry of Health of the Republic of Colombia, and the regulations for health research studies, established in the Declaration of Helsinki in 1964 and its revisions.

RESULTS

A total of 16,151 schoolchildren between 5 and 12 years of age were evaluated, and we found that the distribution by sex was greater in males (52.3%) compared to females; most of the schoolchildren resided in urban areas (70.1%), 54.2% belonged to households classified in the lowest wealth quartile and 78.8% were self-recognized as not belonging to an ethnic group (Table 1).

Of the 6,388 adolescents aged 13 to 17 years, 56.7% were male; 72.1% and 25.2% resided in the urban area and the central region, respectively; 73.8% belonged to households classified in the lowest and low wealth quartiles and the majority (81.5%) were self-recognized as having no ethnic affiliation (Table 2).

On the other hand, we observed that the medians of ioduria for schoolchildren are different by sex, it was higher in males (415 µg/L). When comparing by age, boys and girls from 8 to 12 years old showed significantly higher medians than those found in children from 5 to 7 years old; regarding geographic area, we found that the median was higher in those from urban areas (410.5 µg/L) when compared to those from rural areas (p=0.005). Regarding the regions, we found that the Atlantic region had the highest median (423.7 µg/L) and the Pacific region the lowest (381.2 µg/L) (p=0.001). By wealth index and ethnicity, those belonging to the lowest quartile and indigenous people were those with the lowest medians, with 400.6 µg/L and 349.3 µg/L respectively, and with statistically significant differences (p=0.001) (Table 1).

In adolescents aged 13 to 17 years (Table 2), the median ioduria levels between males and females showed statistically significant differences (p=0.001), it was found to be higher in males (426.4 µg/L). By age and geographic area, no significant differences were found. By region, statistical differences were observed between the medians of those from the Central region (427.7 µg/L) and those from other regions (p=0.001). The lowest medians were found in the indigenous population (370 µg/L).

According to our results, 4.4% of schoolchildren had ioduria levels below 100 µg/L, corresponding to deficiency; of these, 2.1% had ioduria levels between 50 and 99 µg/L and 2.2% between 20 and 49 µg/L, corresponding to mild and moderate deficiency, respectively. On the other hand, 13.0% of these children had concentrations between 200 and 299 µg/L, which is considered to be at risk of excessive intake; however, the highest percentage of schoolchildren (75.2%) presented ioduria higher than 300 µg/L, which is considered as excessive iodine intake.

In the group of adolescents, 2.8% presented ioduria lower than 100 µg/L, which is considered as deficiency, of these, 1.2% had ioduria levels between 50 and 99 µg/L which correspond to mild deficiency and 1.6% between 20 and 49 µg/L, which correspond to moderate deficiency. Of these adolescents, 12.4% had concentrations between 200 and 299 µg/L and 78.4% had ioduria above 300 µg/L, which is considered as risk of excessive iodine intake and excessive iodine intake, respectively.

When analyzing children with ioduria higher than 300 µg/L, we found that three out of four school children had this condition with statistically significant differences by sex (p=0.01), where boys showed three percentage points more (76.5%) compared to girls. By age, statistically significant differences (p=0.001) were found between 7-year-old children who showed the lowest prevalence (72.2%) of elevated ioduria compared to 12-year-old children (79.0%). Regarding

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Table 1. Socio-demographic characteristics and distribution of median ioduria in the Colombian schoolchildren population aged 5 to 12 years.

Characteristics	n	Proportion %	Median (μg/L)	25 Percentile (μg/L)	75 Percentile (μg/L)	p Value*
Sex						
Male	8,441	52.3	415.0	307.0	485.8	0.001
Female	7,710	47.7	394.8	292.6	470.4	
Age in years						
5	2,134	13.2	392.5	287.7	475.0	0.001
6	1,886	11.7	399.0	296.2	479.7	
7	1,990	12.3	399.3	275.8	475.0	
8	1,999	12.4	412.2	307.5	481.3	
9	2,084	12.9	410.9	313.4	481.2	
10	1,944	12.0	410.3	292.8	474.8	
11	2,103	13.0	409.5	304.9	488.9	
12	2,011	12.5	410.0	319.0	482.0	
Area						
Urban	11,319	70.1	410.5	311.0	482.0	0.005
Rural	4,832	29.9	393.7	272	472.1	
Region						
Atlantic	3,529	21.9	423.7	324.9	494.0	0.001
Oriental	2,543	15.7	390.2	279.5	476.0	
Orinoquía and Amazonia	2,878	17.8	390.2	274.3	455.4	
Bogotá	961	6.0	400.4	309.9	471.3	
Central	3,714	23.0	419.5	311.0	490.0	
Pacific	2,526	15.6	381.2	268.6	455.2	
Wealth index						
Lowest quartile	8,761	54.2	400.6	283.5	478.5	0.001
Low quartile	3,748	23.2	411.3	310.8	481	
Middle quartile	2,427	15.0	405.6	318	477.5	
High quartile	1,215	7.5	412.0	316.3	481.3	
Ethnicity						
Afro descendant	1,655	10.2	402.9	284.4	474.8	0.001
Indigenous	1,630	10.1	349.3	174.0	450.9	
Without ethnic belonging	12,722	78.8	409.4	308.0	481.3	
Total	16,151	100	406.8	301.0	479.2	

*Mann Whitney U-test

geographic area, prevalence was higher in urban (77.2%) than in rural areas (p=0.001). Schoolchildren from the lowest wealth quartile showed the lowest medians (72.0%), while in the other quartiles prevalence ranged from 76.5% to 78.4%. We observed significant differences by region between schoolchildren with medians classified as excessive iodine intake in the Atlantic region (79.6%) and those found in the Pacific region (69.3%) where the lowest percentage (69.3%) was obtained; there were no statistically significant differences between Bogota and the Central region (Table 3).

In adolescents aged 13 to 17 years, significant differences were found by sex and geographic area with respect to excessive iodine intake; when comparing by age, significant differences (p=0.039) were only observed between adolescents aged 14 years, who had the highest prevalence (81.0%) and those aged 16 years, with the lowest percentage (75.8%). By region, no significant differences were found; by wealth index, we found that the lowest quartile showed the lowest prevalence (76.5%) and the highest quartile the highest (81.5%). By ethnicity, those self-recognized as not belonging to an ethnic group had the highest prevalence (79.1%) compared to 66.5% (p=0.05) among indigenous people (Table 4).

The results of applying the logistic model in the population aged 5 to 12 years (Table 5), showed that the

Table 2. Sociodemographic characteristics and distribution of median ioduria in the Colombian adolescent population aged 13 to 17 years.

Characteristics	n	Proportion (%)	Median (µg/L)	Percentile 25 (µg/L)	Percentile 75 (µg/L)	p Value*
Sex						
Male	3,622	56.7	426.4	337.0	492.6	0.001
Female	2,766	43.3	398.0	303.0	471.0	
Age in years						
13	1,372	21.5	399.6	310.7	484.1	
14	1,247	19.5	419.8	333.0	487.4	
15	1,309	20.5	412.8	329.0	484.0	0.355
16	1,322	20.7	415.2	304.4	484.7	
17	1,138	17.8	403.2	321.6	480.0	
Area						
Urban	4,607	72.1	416.4	325.4	485.9	0.086
Rural	1,781	27.9	396.2	293.6	475.0	
Region						
Atlantic	1,329	20.8	408.9	319.0	492.8	
Oriental	1,083	17.0	413.3	322.0	478.0	
Orinoquía and Amazonia	1,055	16.5	404.9	306.8	466.9	0.001
Bogotá	411	6.4	410.7	320.5	484.1	
Central	1,614	25.3	427.7	330.1	496.3	
Pacific	896	14.0	394.9	299.4	466.0	
Wealth index						
Lowest quartile	3,211	50.3	403.7	309.0	482.0	
Low quartile	1,502	23.5	420.8	333.1	488.8	0.002
Middle quartile	1,057	16.5	400	304.0	479.0	
High quartile	618	9.7	427	336.5	484.1	
Ethnicity						
Afro descendant	558	8.8	411.0	316.4	489.1	
Indigenous	567	9.0	370.0	258.3	457.4	0.001
Without ethnic belonging	5,210	82.2	412.3	320.5	484.1	
Total	6,388	100	410.8	318.0	484	

*Mann Whitney U-test

variables that are related to excessive iodine intake were geographic region, ethnicity, region and the wealth quartile. What we identified is that the population located in the rural area and indigenous people have a lower probability of having excessive iodine intake, while those located in the Atlantic region and belonging to the middle and high wealth quartile, present a higher probability of having this condition. On the other hand, in adolescents, the significant variables related to medians greater than 300 µg/L were geographic area and ethnicity, where the population located in the rural area and indigenous people presented lower probability of having excessive iodine intake (Table 6).

DISCUSSION

This is the first time in approximately two decades that a population-based study with national representativeness and regional differentiation has been carried out in Colombia to measure urinary iodine levels in schoolchildren and adolescents. Ioduria is the standard indicator defined by WHO to monitor iodine status, taking into account that more than 90% of the iodine consumed is excreted in the urine.

This study showed that Colombia has a prevalence of total iodine deficiency similar to the data obtained from countries such as Cuba, with 6.4% [16]. This situation is not comparable with studies carried out in more than 50

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Table 3. Prevalence of excessive iodine intake in Colombian schoolchildren aged 5 and 12 years old.

Characteristics	N*	Prevalence	95% CI
Sex			
Male	8,441	76.5	74.9-78.0
Female	7,710	73.8	72.1-75.5
Age in years			
5	2,134	72.2	68.5-75.6
6	1,886	74.6	71.5-77.5
7	1,990	71.6	68.2-74.9
8	1,999	76.5	73.0-79.6
9	2,084	77.7	75.0-80.2
10	1,944	73.9	70.7-76.9
11	2,103	75.6	72.5-78.4
12	2,011	79.0	76.5-81.4
Area			
Urban	11,319	77.2	75.8-78.5
Rural	4,832	70.2	67.4-72.9
Region			
Atlantic	3,529	79.6	77.3-81.7
Oriental	2,543	71.4	68.1-74.5
Orinoquía and Amazonia	2,878	70.2	66.5-73.6
Bogotá	961	76.6	72.4-80.3
Central	3,714	77.4	75.4-79.2
Pacific	2,526	69.3	66.1-72.4
Wealth index			
Lowest quartile	8,761	72.0	69.9-73.9
Low quartile	3,748	76.5	74.5-78.4
Middle quartile	2,427	78.4	76.1-80.6
High quartile	1,215	78.1	73.9-81.7
Ethnicity			
Afro descendant	1,655	72.0	67.7-76.0
Indigenous	1,630	59.3	49.7-68.2
Without ethnic belonging	12,722	76.5	75.3-77.7
Total	16,151	75.2	74.0-76.4

* Number of records of the total sample used in the calculation of the prevalence indicator.
95% CI: 95% confidence intervals

Table 4. Prevalence of excessive iodine intake in Colombian adolescents between 13 and 17 years of age.

Characteristics	N*	Prevalence	95% CI
Sex			
Male	3,622	81.1	79.3-82.9
Female	2,766	75.5	72.7-78.0
Age in years			
13	1,372	78.3	74.4-81.7
14	1,247	81.0	77.7-83.8
15	1,309	79.2	75.6-82.4
16	1,322	75.8	71.8-79.4
17	1,138	78.0	74.2-81.4
Area			
Urban	4,607	79.9	78.1-81.7
Rural	1,781	74.1	70.6-77.3
Region			
Atlantic	1,329	79.9	76.4-83.1
Oriental	1,083	79.0	75.2-82.4
Orinoquía and Amazonia	1,055	76.8	70.9-81.8
Bogotá	411	78.8	73.6-83.1
Central	1,614	79.1	76.0-81.9
Pacific	896	74.7	70.3-78.7
Wealth index			
Lowest quartile	3,211	76.5	74.0-78.8
Low quartile	1,502	80.2	77.3-82.8
Middle quartile	1,057	77.6	73.5-81.1
High quartile	618	81.5	76.7-85.4
Ethnicity			
Afro descendant	558	76.7	71.0-81.5
Indigenous	567	66.5	57.5-74.4
Without ethnic belonging	5,210	79.1	77.4-80.7
Total	6,388	78.4	76.8-80.0

* Number of records of the total sample used in the calculation of the prevalence indicator.
95% CI: 95% confidence intervals

countries in different parts of the world, both with marginal economies and in industrialized regions, where iodine deficiency is the most predominant public health problem [17]. The prevalence of deficiency reported for Europe is 52.0%, followed by the Eastern Mediterranean (47.2%) and Africa (41.5%), the lowest percentages in descending order were for Southeast Asia, Western Pacific and the Americas (30.0%, 21.2% and 11.0%), respectively [18].

The findings in Colombia show a median ioduria considered by the WHO as excessive iodine intake, with results much higher than those reported in Venezuela [19], Brazil [20] and Argentina [21], places where the median ioduria is within the adequate ranges.

Other studies, which even report lower medians than those found in this study, are still considered by the WHO as above the requirements, for example, a study of the department of Quindio (Colombia) with a median ioduria of 272μg/L [9], Salvador where medians of 206 μg/L were obtained [22] or studies in Peru, which showed medians ranging from 258.5 μg /L to 262.4 μg/L [6-23]. Another example is the situation in Costa Rica [24], which showed a median of 314 μg/L which, although classified as excessive iodine intake by the WHO, is lower than the median found in Colombia.

There are few studies that report values higher than those from this study and that are classified by the WHO as excessive iodine intake, one of them was carried out in 139

Table 5. Analysis of factors associated with excessive iodine intake according to sociodemographic characteristics in Colombian schoolchildren aged 5 to 12 years.

Variable	Crude OR	95% CI	Adjusted OR*	95% CI
Age	1.04	1.01-1.07	1.04	1.01-1.07
Sex				
Female	1.00		1.00	
Male	1.16	1.03-1.30	1.16	1.03-1.30
Area				
Urban	1.00		1.00	
Rural	0.70	0.59-0.82	0.70	0.59-0.82
Ethnicity				
Afro descendant	1.00		1.00	
Indigenous	0.56	0.35-0.92	0.57	0.35-0.93
Without ethnic belonging	1,27	1.03-1.56	1.27	1.03-1.56
Region				
Other regions	1.00		1.00	
Atlantic	1.40	1.19-1.63	1.40	1.19-1.63
Central	1.17	1.02-1.33	1.16	1.02-1.33
Wealth quartile				
Lowest quartile	1.00		1.00	
Low quartile	1.26	1.10-1.47	1.27	0.99-1.35
Middle quartile	1.41	1.20-1.67	1.41	1.20-1.67
High quartile	1.39	1.08-1.78	1.38	1.08-1.77

* Adjusted for age and sex
OR: Odds ratio, 95% CI: 95% confidence intervals.

schoolchildren in Popayán, Colombia, where the median ioduria was 510.3 µg/L [8], as well as those from Paraguay that reported a median of 437 µg/L [25].

Different studies show that the increase in the medians could have different causes such as the addition of high levels of iodine to salt, high concentrations of iodine in drinking water, consumption of foods with high levels of iodine or other unstudied factors that could be influencing the excessive excretion of iodine in urine [26].

Several authors have defined that the most probable cause for this condition in the Colombian population is the high concentration of iodine defined in the Colombian regulation for salt fortification with iodine [8-9], which is between 50 and 100 mg/kg [27], considered at the Latin American level as one of the highest doses, compared to other countries such as Argentina, Peru, Uruguay and Mexico where the concentration of iodine is between 20-40 ppm [28] and well above the WHO recommendation [29]. China, for example, had a situation similar to what is happening in Colombia and reduced the concentration of iodine in salt, achieving a decrease in ioduria in schoolchildren between 8 and 10 years of age to such an extent that its median went from being classified by WHO as levels above the recommended levels to adequate levels [30].

In addition to the addition of salt in Colombia, data showed that males in both the schoolchildren and adolescent population showed higher median values considered as excessive iodine intake, which may be related to the higher dietary intake compared to females. Regarding the analysis by geographic area, our findings coincide with those reported by other studies, where it was found that the medians of ioduria are higher in schoolchildren living urban areas than those living in rural areas [9].

Regarding ethnicity and wealth index, it is not possible to make comparisons with other studies due to the lack of evidence from these analyses. But according to our results, there are more school children and adolescents with ioduria medians considered as excessive iodine intake among the population in the high wealth quartile and in the group with no ethnic affiliation. This could be related to eating habits, access to industrialized or processed foods for human consumption, being these the only ones covered by the salt iodization decree and that have additives such as calcium and potassium iodate, so salt is not the only source of iodine since drinking water includes in the potability process the addition of iodine [27].

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Table 6. Analysis of factors associated with excessive iodine intake according to sociodemographic characteristics in Colombian adolescents between 13 and 17 years of age.

Variable	Crude OR	95% CI	Adjusted OR*	95% CI
Age	0.97	0.91-1.03	0.95	0.90-1.03
Sex				
Female	1.00		1.00	
Male	1.40	1.16-1.68	1.40	1.17-1.69
Area				
Urban	1.00		1.00	
Rural	0.72	0.58-0.88	0.71	0.58-0.88
Ethnicity				
Afro descendant	1.00		1.00	
Indigenous	0.61	0.37-0.98	0.61	0.38-0.97
Without ethnic belonging	1.15	0.85-1.56	1.16	0.85-1.57
Region				
Other regions	1.00		1.00	
Atlantic	1.13	0.90- 1.42	1.13	0.89-1.43
Central	1.05	0.86-1.30	1.06	0.86-1.30
Wealth quartile				
Lowest quartile	1.00		1.00	
Low quartile	1.24	1.00-1.53	1.25	1.00-1.54
Middle quartile	1.06	0.83-1.36	1.07	0.83-1.39
High quartile	1.35	0.98-1.86	1.37	0.99-1.88

* Adjusted for age and sex
OR: Odds ratio, 95% CI: 95% confidence intervals.

The strengths of this study are the size and representativeness of the sample in relation to the national territory, which allowed disaggregated analyses for all the variables defined in the ENSIN. In addition, the quality of the urine samples is to be highlighted; however, there was no evaluation of thyroid function and autoimmunity and there was no information related to iodine content in table salt of the people surveyed, nor were the levels of iodine or salt consumption in the intake estimated.

In conclusion, it is essential to review the fortification process to modify the current salt iodization decree and reduce its concentration to the levels suggested by the WHO, in addition to implementing systems to monitor the ioduria situation in the population to control the levels of excessive iodine intake. Considering the above, we suggest that there should be more research in order to evaluate access to iodine sources, dietary habits associated with salt consumption, and iodine levels in salt for human consumption.

Iodine deficiency in this population is low, but it is necessary to identify it in order to implement specific strategies and reduce the risk of IDD. However, the public health problem in the schoolchildren and adolescent population in Colombia is excessive iodine intake, which in addition to being mainly associated with the high concentration of iodine added in the salt fortification process, it was shown that older age, living in urban areas, being located in the Atlantic and Central regions, belonging to the upper quartile of wealth and being recognized as not belonging to an ethnic group, increases the probability of schoolchildren to have excessive iodine intake; the same situation was observed for male adolescents and residents of the urban areas.

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