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ORIGINAL ARTICLE

Influence of parental eating behaviors on salt/sodium intake in children and adolescents in Costa Rica

Influencia de las conductas alimentarias de los progenitores en el consumo de sal/sodio en niños y adolescentes de Costa Rica

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What do we know about the subject matter of this study?

In Costa Rica, high sodium intake is associated with cardiovascular disease. Dietary habits in childhood influence cardiovascular health in adulthood. It is crucial to address excess sodium intake in young people to prevent these diseases.

What does this study contribute to what is already known?

This study, with 1,467 mother/father-child dyads, showed that young people consume 3,245 mg of sodium daily, increasing to 3,990 mg with salt added to ready-to-eat foods. Predictive factors include parental cooking practices such as the use of seasonings, sauces, and salt shakers. BMI and the age of the young person also play a role. Parents who check labels protect their children against excess sodium intake.

Abstract

One of the key factors influencing salt and sodium intake in children and adolescents is the dietary behavior of their parents and/or caregivers. **Objective:** To evaluate the relationship between parental dietary behaviors and salt/sodium intake in children and adolescents in Costa Rica. **Subjects and Method:** A descriptive cross-sectional study of primary and secondary education students from 40 schools and 24 colleges located in the seven provinces of Costa Rica, along with their parents (father or mother). Sociodemographic variables were evaluated, weight and height were measured, and a weekly food consumption frequency survey was used. Standardized methods were used to estimate the sodium content of the foods, asking about the amount of salt added to them. Interviews were conducted with parents to explore their cooking practices. Food portion sizes were estimated using standardized pictures. After bivariate analysis, multiple regression analysis was performed to examine possible associations between the independent variables and daily sodium intake. **Results:** 1,497

Keywords:
Salt;
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students were included. 97% of them exceeded the maximum recommended limit of sodium intake (2,300 mg/day). An increase in sodium intake was associated with the use of salad dressings, Worcestershire sauce, amount of added salt, dehydrated soups, and having a saltshaker on the table. The intake was lower in females. Those students whose parents used only common salt for cooking and checking the sodium content on food labels were associated with lower intake ($p < 0,001$). The amount of salt used for cooking correlated directly with children's sodium intake. **Conclusions:** Given that salt intake habits influence sodium intake, it is suggested to develop comprehensive interventions to reduce excessive sodium intake in children, adolescents, and their families.

Introduction

Worldwide, excessive sodium intake is a serious public health problem with evidence linking high sodium intake with cardiovascular diseases (CVDs) and associated deaths[1]. In Costa Rica, CVDs are the leading cause of mortality[2]. Intake greater than 2,300 milligrams of sodium (5 grams of salt) is closely associated with elevated blood pressure, a major risk factor for CVDs[3]. It is crucial to address dietary risk factors, including sodium intake in children, because blood pressure (BP) levels in childhood are related to high BP in adulthood[4,5].

Infants and young children around the world consume excessive amounts of sodium, exceeding the recommended limits[6,7]. To minimize the risk of chronic disease, the National Academies of Sciences, Engineering, and Medicine (NASEM) recommend reducing sodium intake in children to 1,500 mg/day between the ages of 4 and 8 years and 1,800 mg/day between the ages of 9 and 13 years[8]. Evidence suggests that a reduction of daily salt intake of 3 grams on average could reduce by 13% the risk of stroke and by 10% the risk of ischemic heart disease[9]. Therefore, identifying the sources of salt/sodium intake and implementing measures to reduce their consumption is a cost-effective strategy to prevent chronic diseases[10].

Few data are available on excess sodium intake in children compared with adults[11]. Previous studies have focused mainly on determining dietary sources of sodium in children and adolescents[12]. In Costa Rica, a high daily sodium intake has been observed in this young population; it has been estimated at 8.17 g of salt (3214 mg sodium) with a consumption of 1.1 g (445 mg sodium) on average of salt added to ready-to-eat foods[13]. When considering the amount of salt added to the foods served, the average sodium intake for children and adolescents aged 7 to 18 years increases to 3,434 mg sodium (8.74 g salt). This figure is higher than that reported by children from Portugal, Spain[14,15], Germany, and the United Kingdom[16].

The adoption of a healthy diet early in life is essential to prevent CVDs[17]. Dietary patterns in childhood and the family environment influence the food preferences and diet of children[18]. However, data on the culinary practices and dietary behaviors of Costa Rican parents regarding salt/sodium use and their correlation with their children's intake are lacking. The objective of this study is to analyze parental practices and behaviors as a function of salt/sodium intake in children and adolescents and to establish associations.

Subjects and Method

Type of study and population selection

Descriptive and cross-sectional study. The population consisted of primary education students (I and II cycles) and secondary education students (III cycle) from public, private, and subsidized private schools and high schools. Data from the Department of Statistical Analysis of the Ministry of Public Education shows that in Costa Rica, around 32% of students are in primary education and 68% in secondary education, distributed across 4,070 schools and 589 high schools.

To determine the sample size, the proportion estimation formula was used, with a 95% confidence interval and a 3% margin of error. The calculation was made considering a maximum variability (P = 0.5) and the design effect was estimated at 2. In addition, in order to anticipate possible cases of rejection, the non-response rate was 15%. Since the educational centers are classified into 27 regional departments, these were used as strata to distribute the sample proportionally according to enrollment in the respective educational centers. The random selection of schools and sections was carried out following the systematic method. To ensure representativeness, two groups were randomly selected in each educational center; o0n average 23 students were selected, but the number of participants ranged from 20 to 40, depending on the enrollment of the educational center.

The only inclusion criterion was age from 7 to 17 years. The exclusion criteria were incomplete participant information, inability to read and write, history of eating disorders, celiac disease, or diabetes mellitus,

and dependence on alcohol or illicit drugs. A total of 1,467 students were selected from 64 educational centers (40 schools and 24 high schools), together with their parents (father or mother), in the seven provinces of Costa Rica, being a nationally representative sample. The information of five students was not completed, so they were eliminated from the study.

Sociodemographic variables such as sex, age of both students and parents, and socioeconomic level were determined. For the latter, the methodology of Madrigal[19] was followed, whereby each of the participating students was asked about the possession of certain material goods in the home. The answers were corroborated by interviewing the father/mother or other person in charge of the student.

Body weight was measured with a Tanita scale and height was measured with a stadiometer. BMI was estimated by dividing weight (kg) by height (m^2) and cut-off criteria were based on sex-specific BMI-for-age growth charts[20]. Height and waist were measured twice for each participant and the average was calculated; a third measurement was performed if there was a difference > 0.5 cm. Measurements were performed by previously trained professionals.

To assess the food and beverage consumption habits of the students, a food intake frequency survey was adapted from a previous study conducted by the research team. The validated questionnaire to assess food intake frequency was applied individually with the supervision of two nutritionists. Children attending the first, second, and third year of primary school were interviewed. Each participant was asked, only once, about what she/he usually ate and drank during the 7 days of the week or month. The survey included a list of commonly consumed foods in Costa Rica, with an open section for students to add any additional items[21]. The list included 120 foods, either homemade or industrialized products, representing the Costa Rican diet and the overall habits of children and adolescents. These foods were categorized into 25 groups (table 1) according to their nutritional characteristics to estimate sodium intake and identify the main contributors to sodium intake in this population[22]. Portion sizes of the foods recorded were estimated by each student using the Photographic Manual of Portions of Common Foods and Preparations in Costa Rica and the Weights of Home Measurements and Portions of Common Foods and Preparations in Costa Rica Book[23,24].

To estimate the sodium content of foods, indirect and direct methods were used to provide the best approximation of sodium intake from an early age[25]. In order of importance, the sources were as follows: Method 1 consisted of a laboratory analysis performed by Montero-Campos et al[26] to determine the sodium content of commonly prepared Costa Rican foods. These foods included dishes such as *casado*[a], *gallo pinto*[b], sweet stuffed bread, *empanada*[c], French fries, tacos, hamburger, ham and cheese pizza, baguette with cheese, fried chicken, Cantonese rice, rice with chicken, corn tortilla with cheese, *chorreadas*[d], savory stuffed bread, hot dogs, mixed nachos, and beef stew. The sodium content for these foods was assigned based on the lower limit reported[26].

Method 2 consisted of determining the sodium content of foods using the Central American Food Composition Table of the Institute of Nutrition of Central America and Panama (INCAP)[27]. This method was applied to foods not included in Method 1.

For foods whose sodium content was not determined by either Method 1 or 2, Method 3 was used which consisted of obtaining information from the commercial nutrition label and estimating the sodium content per 100 gr from the serving size indicated on it and from the USDA Food Composition Databases[28].

Method 4 was focused on calculating the sodium content of prepared foods that usually contain multiple ingredients. Standardized recipes provided in the Weights of Home Measurements and Portions of Common Foods and Preparations in Costa Rica Book[24] were used for this purpose.

The formula used for sodium estimation was: [(Serving size in grams) X (100 grams)] / (Sodium content in 100 grams). To calculate the daily sodium intake in grams, the following formula was used: Number of estimated servings X frequency factor X grams per serving. Frequency factors ranged from 0 (Never) to 1 (7 days a week)[29,30].

To estimate the amount of common salt added by the students to their meals or foods (except for cooking), each student was asked about her/his salt intake. The mean amount of common salt and the frequency of "pinches" (the amount of salt held between thumb and forefinger) used by each student were calculated. The weight of a "pinch" was estimated using a grain scale, showing 0.359 gr on average of common salt or 142 milligrams of sodium[13].

Students were asked about the use of soy or spiced vegetable sauces (Worcestershire sauce), tomato or pink sauces, and seasonings in their meals, as well as the frequency of use including sauces and seasonings on Chinese food, French fries, and bread. The amounts of sauces and seasonings were estimated based on the theoretical weights indicated in the food composition databases consulted[27,28] and their content was esti-

[a]Typical Costa Rican dish of rice and beans with chicken, beef, or pork.

[b]Typical dish made by combining rice and beans.

[c]A fried or baked pastry filled with meat, cheese, or beans, often made with corn dough.

[d]Sweet corn tortilla.

Table 1. List of foods, beverages, and preparations investigated by the national survey in 1467 Costa Rican children and adolescents aged 7 to 18 years

Food groups	Foods, beverages, and preparations
1. Meats with visible or fried fat, either alone or in combination (such as fried chicken)	Chicken, pork rinds, beef, or pork ribs with bacon.
2. Soy or spice-based sauces (Lizano®)	Soy and spicy sauces (such as Lizano® a type of Worcestershire sauce), among others.
3. Deep-fried pastries and sandwiches	Puff pastry, "empanadas", "churros", among others.
4. Fast food items	Pizza, hot dog, beef taco, ham and cheese pizza, fried chicken, Cantonese rice, chicken and rice, cheese tortilla, chorreadas, hamburger, mixed nachos, Chinese food, among others.
5. Tomato (ketchup) or pink sauce	Tomato or pink sauce (a mixture of tomato sauce and mayonnaise).
6. Cereals and/or gallo pinto (a traditional Costa Rican dish of rice and beans)*	Non-whole and whole grains: rice, barley, oats, breakfast cereals, tortillas, breads, stuffed salted bread, baguette with cheese, gallo pinto (rice and beans dish), among others.
7. Salted seeds	Almonds, nuts, among others, with salt.
8. Processed meats and sausages	Sausage, mortadella, chopped meat.
9. Crackers	Any type of cracker (filled or unfilled).
10 Snacks in small packages	Roasted potatoes, fried plantains, among others.
11. Popcorn	Popcorn of any kind, with salt.
12. Aged or creamy cheeses	Yellow cheese of any kind; fully ripened (not white or fresh), suitable for melting or frying.
13. Milk and dairy products high in fat	Skimmed or semi-skimmed milk, yogurt, and fresh white cheese (not ripe or creamy); whole milk and flavored milk.
14. Lean meats (not fried)	Chicken, fish, tuna, scrambled eggs (not fried).
15. Salad dressings	Mayonnaise, cream cheese, mustard, among others.
16. Soups	Ready-made soups (instant) ready to heat and consume.
17. Red meats and eggs, either alone or in combination	No visible fat: beef, pork, chicken eggs.
18. Legumes	Beans of any color, lentils, chickpeas, peas.
19. Starchy vegetables	Potatoes, cassava, sweet potatoes, cocoyam, ñampí, among others.
20. Sweet treats and creamy ice cream	Sweets, chocolates, creamy ice cream of any kind.
21. Non-starchy vegetables	Snow peas, carrots, cabbage, tomatoes, tender squash, lettuce, cucumbers, among others.
22. Fruits	Papaya, melon, watermelon, bananas, guava, soursop, oranges, tangerines, among others.
23. Sports drinks	Sports drinks.
24. Energy drinks	Energy drinks.
25. Other beverages	Cola soda, citrus-flavored soda, other carbonated drinks, concentrated juices (powdered or packaged) with added sugar, flavored water, beer, white or red wine, sparkling wine, whiskey, vodka, rum, among others.

*Typical Costa Rican dish. Source: primary data obtained by the researchers of this study.

mated from food composition tables. The mean daily amount of salt/sodium intake was calculated and compared with the maximum recommended salt intake.

Interviews were conducted with the student's father or mother, using a semi-structured guide to explore their cooking practices, including a) the frequency of use of seasoning, sauces, and salt, among other industrialized products in the preparation of food and at the time of consumption; b) dietary behaviors on the part of parents in relation to the use of salts other than common or discretionary salt; the use of the salt shaker at the table; the amount of salt they use to cook a cup of rice; and the review by parents of the sodium content declared on the nutritional labeling of prepackaged foods. The anal-

ysis of these behaviors was carried out by comparing the median daily sodium intake values of students based on the frequency of parental feeding behaviors (never or sometimes vs. almost always or always).

Statistical analysis of the data was performed with the SPSS software (SPSS Inc., version 25.0 for Windows, Chicago, IL, USA). Frequencies were calculated and continuous variables were described by mean and standard deviation. A p-value < 0.05 was considered statistically significant. Differences between groups were evaluated using parametric or nonparametric tests based on the distribution of the data. For data with more than two categories, ANOVA or Kruskal-Wallis tests were used.

To examine the possible associations between the independent variables and the dependent one (the daily sodium intake of children and adolescents), a multiple regression analysis was performed. All predictor variables were included in the analysis and the selection process was performed manually.

The models were adjusted for various factors, such as age, BMI, and sex (1 = girls) of the students, socioeconomic level, years of schooling, and age of parents. Culinary practices and parental salt-related behaviors were incorporated as dichotomous variables. None of the predictor variables showed collinearity problems and the final model was holistic and economic (parsimonious).

Table 2. Sociodemographic characteristics of the study population

Characteristic	n	Percentage
Total	1.467	100.0
Age group (years)		
7-9	202	13.8
10-12	547	37.3
13-15	521	35.5
16-18	197	13.4
Sex		
Male	710	48.4
Female	757	54.6
Socioeconomic level		
Low	399	27.2
Medium	845	57.6
High	223	15.2
Overweight		
Yes	387	26.4
No	1.080	73.6
Parents		
Mothers	1243	84.7
Fathers	224	15.3
Age group of parents(years)		
Less than 35 years	552	37.6
35 to 49 years	663	45.1
More than 49 years	252	17.2

Results

1467 mother/father-child dyads were studied; the information of five students was not completed, mainly the feeding part. Table 2 shows the sociodemographic characteristics of both students and parents.

Salt/sodium intake in the student population

The mean daily sodium intake in children and adolescents aged 7 to 18 years was 3245 ± 812 mg and almost 97% of the students exceeded 2300 mg per day. The top 10 food groups contributing to sodium intake in children and adolescents were: 1) Meats with visible fat or fried, served either separately or in *casado* (mainly with fried chicken); 2) Soy or spice sauces (like Worcestershire sauce); 3) Fried sweet pastries and snacks; 4) Fast food; 5) Tomato sauce (ketchup) or pink sauce; 6) Cereals and/or *gallo pinto*; 7) Salted seeds; 8) Processed meats/sausage; 9) Cookies; and 10) Packaged snacks. These 10 food groups contributed about 63% of the sodium consumed by children and adolescents aged 7 to 18 years, with the remaining 37% coming from the other 15 food groups (table 1). Sodium intake, excluding salt added to prepared and ready-to-eat food or other foods, varied by age group, sex, and nutritional status (table 3). Approximately half of the students reported adding at least 1 "pinch" of salt to their daily food with a frequency ranging from 1 to 4 days per week (data not shown). When considering the sodium added to the plate, the mean sodium intake went from 3245 ± 812 grams to 3990 ± 1217 grams, this difference is significant and varied by age group, sex, socioeconomic status, and nutritional status (table 3).

Culinary practices and salt/sodium-related eating behaviors of students' families

Figure 1 shows the culinary practices and behaviors related to salt/sodium use and consumption among the 1467 parents. Among their preparations, the use of common salt, soy sauce, tomato sauce, Worcestershire sauce, dehydrated soups/creams, packaged/canned sauces, and flavored bouillon cubes stand out.

In relation to parental dietary behavior on the use of other types of salt besides common salt, it was observed that the median daily sodium intake of students whose parents never or sometimes used other types of salt was significantly lower ($p < 0.001$) than that of those whose parents almost always or always used

Table 3. Comparison of the mean (± standard deviation) of daily sodium intake, without added salt and with salt added to the plate and to the foods served, by age group, gender, socioeconomic level and nutritional status in 1467 Costa Rican children and adolescents aged 7 to 18 years old

Variable	Mean sodium intake (mg/d ± standard deviation) of children and adolescents					
	They do not add salt to served foods	n	p	They add salt to served foods	n	P
Age Groups						
7-9	Reference Group	122	Reference Group	3139 ± 922	80	Reference Group
10-12	3407 ± 797	295	< 0.001	4119 ± 1098	252	< 0.001
13-15	3237 ± 811	266	< 0.001	4058 ± 1186	255	< 0.001
16-18	3338 ± 872	95	< 0.001	4325 ± 1484	102	< 0.001
Sex						
Male	3535 ± 868	341	< 0.001	4244 ± 1206	369	< 0.001
Female	2972 ± 649	437		3752 ± 1180	320	
Socioeconomic Level						
Low	3229 ± 792	120	0.977	3844 ± 1152	279	< 0.010
Medium	3230 ± 814	613	0.968	4021 ± 1241	232	0.355
High	3225 ± 839	45	Reference Group	4135 ± 1226	178	Reference Group
Overweight (overweight+obesity)						
Yes	3696 ± 862	185	< 0.001	4633 ± 1252	202	< 0.001
No	3114 ± 749	593		3760 ± 1118	487	

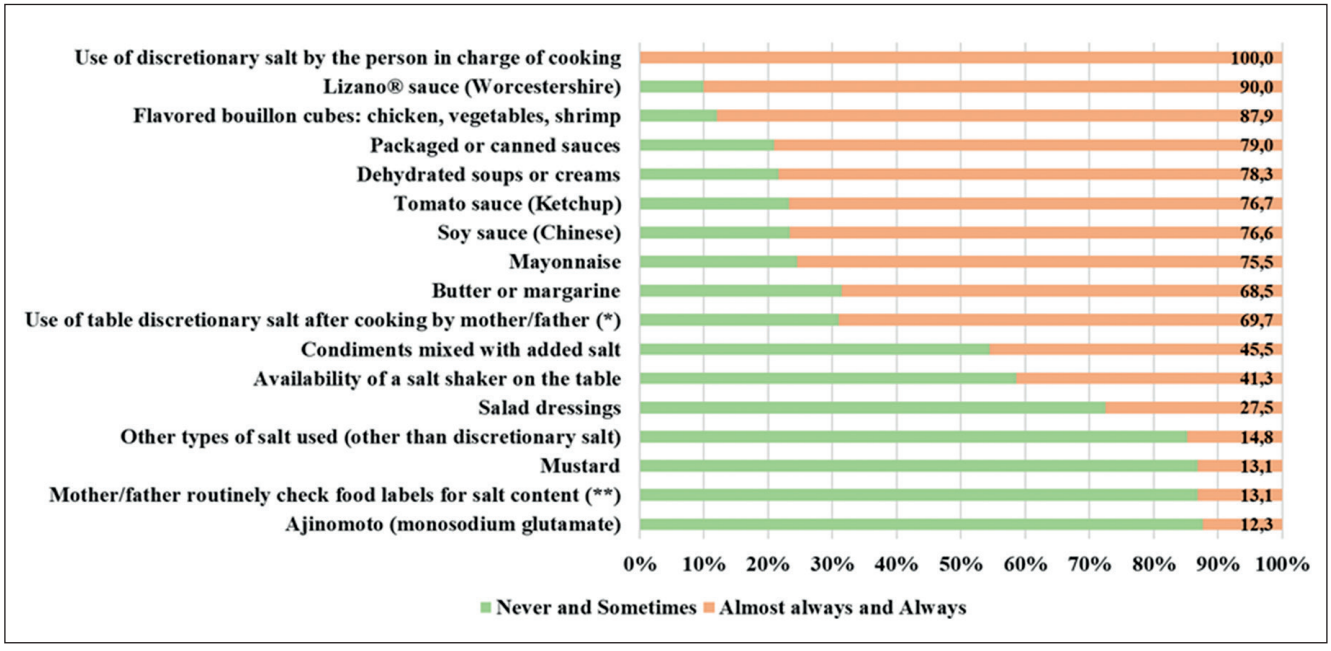

Figure 1. Culinary practices and behaviors related to salt/sodium of students' families.

Table 4. Multiple linear regression model, highlighting the use of products with sodium content in cooking and salt shaker practices at the table by parents, and its association with the daily sodium intake (mg) of their children

Predictors	*B*	Beta	*p*	95% IC para B	
Sex of children; girl=1	-502684	-.206	.000	-597438	-407930
Age of children (years) (continue variable)	34244	.074	.001	14672	53816
BMI of children (continue variable)	49537	.180	.000	37839	61236
Salad dressings*	762030	.278	.000	558361	965699
Soy or spice-based sauces*	754437	.185	.000	558515	950359
Number of salt "pinches" (continue variable)**	545653	.549	.000	507047	584258
Soups or dehydrated creams*	476487	.161	.000	248202	704772
Salt shaker at the table*	196311	.079	.000	100288	292334
Constant	600531				

BMI: Body Mass Index. Dependent Variable: amount of sodium consumed daily by students *1 = "Almost always" and "Always" and, "Sometimes" and "Never"= 0. **Discretionary number of "pinches" of salt on the plate served, fruits, cream, avocado and other foods. Source: primary data obtained by the researchers of this study.

(3832 mg vs 4212 mg) Regarding parental eating behavior related to reviewing the sodium content of food labels, it was observed that, students whose parents almost always or always checked the salt content of food labels had a median daily sodium intake of 3493 mg, compared to those whose parents never or sometimes checked the labels, with a median daily sodium intake of 3907 mg ($p < 0.001$). Finally, the amount of salt parents reported using to cook a cup of rice was directly proportional with the median daily sodium intake of the 1467 students, which ranged from 2553 mg/day to 5655 mg/day ($p < 0.005$).

Regression model on parents' cooking practices and behaviors associated with their children's daily salt/sodium intake

The predictive factors associated with students' daily sodium intake were salad dressings, Worcestershire sauce, number of salt pinches, dehydrated soups or creams, salt shaker at the table, children's BMI, and children's age (years). The predictive factor inversely associated with students' daily sodium intake was being a girl (table 4).

Discussion

In this study, Costa Rican children and adolescents had an average salt intake of 8.1 g/day, and only 3% consumed less than 5 g/day. Considering the average amount of common salt added to dishes or food, the intake increases to almost 10 grams (9975 mg). This figure is higher than the salt intake reported by Portuguese and Spanish children, who consume 7.9 g/day. In these populations, 9% and 15.2% of schoolchildren, respectively, have salt intakes of less than 5 g/day[14, 15], and much higher than those reported in Italian[31], German, and UK children[16]. These differences may be due to several factors such as data collection methods, dietary habits, climate, and age ranges considered in the studies. High sodium intake at a young age may lead to the development of high blood pressure and unhealthy food preferences throughout life[32]. Taste preferences significantly influence children's food choices and consumption patterns[33].

Several barriers contribute to the high salt and sodium intake in Costa Rica in children and adolescents, including a complex food environment with pervasive advertising[34], no monitoring of compliance with the School Sodas Regulation, lack of educational programs on the subject, and difficulties in interpreting the nutritional labeling of foods[35] that hinder efforts to reduce consumption among children and adolescents.

Salt intake in children in south London is high, with processed foods being the main source[16]. In the United States, approximately half of the children's sodium intake comes from 10 food categories (pizza, Mexican mixed dishes, sandwiches, bread, sausages, soups, salty snacks, cheese, milk, and poultry)[36]. This pattern coincides with that of Australian children and Costa Rican children and adolescents. In Australia, sodium intake comes largely from cereal-based products and meat and poultry[37], whereas in Costa Rica it comes from meat and poultry products, fried sweet pastries, sandwiches, fast food, cereals, processed foods, and salt added during meal preparation and to ready-to-eat foods.

To reduce sodium intake, agreements have been

established between the health sphere and the food industry. However, sodium chloride is inexpensive and is widely used in processed foods for various technological functions[38-40], such as improving flavor by suppressing bitterness and enhancing sweetness. The biological need for sodium likely contributes to the human drive to consume it[41].

The widespread use of sodium chloride in processed foods has led to excessive sodium consumption. Effective public communication strategies are crucial to reduce sodium intake levels. The SHAKE guideline of the WHO recommends integrating educational messages with social marketing strategies to raise public awareness of the health risks of excessive salt consumption[42]. These strategies should emphasize the sources of salt and sodium in the Costa Rican diet and the amount added during meal preparation to promote behavioral change.

The intake of salt and added sugars is closely related to the intake of sodium and added/free sugars and this association increases as children get older. In our study, we observed that children's age was a predictor of daily sodium intake[6,43]. Similar findings were reported in studies conducted in the United States and the UK, where sodium intake increased with age[36,44]. These studies highlight the importance of monitoring and controlling the intake of salt and added sugars in children to promote healthier eating habits.

It has been shown that boys tend to consume more sodium than girls[45]. In our study, we also observed that boys had a significantly higher daily salt/sodium intake compared with girls. Being a girl was inversely associated with sodium intake according to multivariate analysis. In addition, the influence of child sex on maternal food choices has been analyzed, revealing that mothers tend to provide higher caloric meals to boys, often including less healthy food categories[46].

Several studies have analyzed the possible connection between salt sensitivity, hypertension, and childhood overweight. A study in Croatia found a significant difference in estimated daily salt intake between hypertensive and normotensive children, with a positive correlation between salt intake, blood pressure, and BMI. In our study, children's BMI was a predictor of their daily sodium intake, underscoring the importance of addressing pediatric obesity and excessive salt intake to reduce the risk of hypertension[47].

Although directly modifying a child's eating behaviors and weight can be challenging, interventions focused on parental feeding practices show promise in preventing unhealthy eating patterns. Eating behaviors in infancy tend to persist, leading to limited dietary variety and high sensitivity to parental eating behaviors, even in infants[18,48].

Families with economic difficulties have been associated with unhealthy eating habits in children during the first years of life[18,48]. However, in our study, no such association was observed for salt/sodium intake. Age, educational level, and parental economic status remained statistically nonsignificant even after adjusting for covariates. This absence of association has been evidenced in the scientific literature[36].

In our study, all participating parents (100%) reported adding salt when preparing meals. Similar behaviors have been described in parents from Spain (92%), Slovakia (98-91%), Norwich (85-77%), Belgium (71-65%), and Australia (67%)[15,49,50]. Based on our data, it is suggested to implement specific salt education programs to raise awareness among parents and children about salt reduction both in and out of the home. Khokhar et al. (2018) reported that parents frequently have behaviors aimed at reducing salt intake in children[49].

The "family health climate" is an important aspect, in which children learn by observing and imitating their parents and caregivers[51]. In our study, the presence of a salt shaker at the table was associated with higher daily sodium intake among students. Similar results have been reported showing a positive association between the presence of a salt shaker at the table and an increased risk of exceeding mean sodium excretion levels, even after adjusting for factors such as sex, age, and BMI[15].

In a study conducted in Spain[15], it was reported that most Spanish families (94%) do not usually have a salt shaker at the table. In contrast, a significant number of Costa Rican students (almost half) reported often adding at least a pinch of salt to their meals, including fruit, custard, avocado, and other foods. Regarding the presence of a salt shaker at the table, more than half of Costa Rican families stated that they sometimes or never have one. Another study conducted in Spain revealed that children whose mothers reported never adding salt to food after cooking had lower levels of sodium excretion compared to those who always added salt. In addition, schoolchildren from families in which the salt shaker was occasionally present at the table excreted more sodium than those who never had the salt shaker[15]. These findings suggest a correlation between parental eating behaviors and children's preferences.

In this study, the association between parental behavior of reviewing sodium information on nutrition labels and the daily sodium intake of students was statistically significant. However, this association lost significance in multivariate linear regression analysis, which is consistent with the results of previous studies[15].

Several factors may have contributed to the lack of association observed in the multivariate analysis. First, the low prevalence of parental behavior in reviewing

sodium information on nutrition labels. Only a few parents did so, but their attention was focused on foods with a salty taste, overlooking other foods that may contain salt/sodium but not have a salty flavor. In addition, some parents may have difficulty understanding the information provided on nutrition labeling, indicating that the legibility and access to this information could be a barrier. Research in U.S. and Japanese adults has shown that reviewing salt content on food labels is associated with a reduction in sodium intake[52,53].

It is crucial to sensitize parents to the relationship between their salt use behaviors and their children's sodium intake. The low proportion of parents who check the sodium content on food labels highlights the need for greater awareness and guidance in interpreting labels, as well as the need to improve nutritional schemes. Educational campaigns can gradually modify habits related to the use of sauces, seasonings, and salt in food preparation. If behaviors such as adding a pinch of salt and consuming sauces and processed products can be reduced or eliminated, daily salt consumption could be reduced by 1 to 2 grams, tripling the reduction potential. This approach can help children and adolescents achieve recommended salt intake levels.

This study has some limitations. First, because it is a cross-sectional study, cause-effect relationships cannot be established. However, it was developed with a representative sample of the Costa Rican student population; the results may be subject to selection bias since there is a probability that this study involves more parents who are particularly interested in the food and nutrition of their children so that they could follow the healthy eating recommendations to a greater extent. Likewise, the existence of some pathologies related to low-sodium diets, such as hypertension and chronic renal disease, was not asked. However, this study showed a low adherence to the recommendation of avoiding salt since a high prevalence of use of added salt was observed.

Second, it is critical to keep in mind that participants' responses may be biased toward responses that they considered socially favorable.

Third, to assess total sodium intake, the gold standard was not available due to a lack of funding. In addition, 24-hour urine sodium excretion is not a complete or absolute method, as it does not report the contribution of specific foods or food groups to total sodium intake, and collecting a 24-hour urine sample in children and adolescents can be complicated due to the necessary precautions. Therefore, some studies with adults and children that have used the gold standard to measure sodium, potassium, and nitrogen excretion have been mixed because they have also used dietary methods.

Fourth, to estimate the sodium content in the foods and products analyzed, we did not use a single method but a mixture, so there could be variations in the sodium estimation. However, the sodium data from the direct method were prioritized over those reported by indirect methods (food composition bases and tables) because they are highly reliable data, given that these values are the result of analyses performed specifically in local foods where there is close control of sampling, analysis, and quality control procedures. That is, only in the case of not having the sodium analysis data of foods and products by the direct method, the indirect methods of the sodium data reported in the food composition databases were used.

Fifth, the data collected from indirect methods could over- or underestimate sodium content as they may not fully capture the reformulation of sodium content that some foods and products have undergone modifications after the reporting of the amount of sodium in the consulted food composition databases and tables.

Among the strengths of our study are: (1) the large sample size and that it is representative of Costa Rican school children and adolescents; (2) the collection instruments were previously validated; and (3) the data were collected by trained professionals.

Conclusions

Multiple parental behaviors influence salt/sodium intake in Costa Rican children and adolescents, such as the use of salad dressings, Worcestershire sauce, amount of salt added, dehydrated soups intake, and having a salt shaker at the table. Being female was inversely associated with sodium intake. Parental cooking practices influenced the sodium intake of children; those whose parents only used common salt for cooking had lower intakes. In addition, checking the sodium content on food labels was associated with lower intake. The amount of salt used for cooking correlated directly with children's sodium intake. These influences tend to be more negative than positive leading to elevated sodium intakes in the national underage population.

These findings should be considered to guide interventions in Costa Rican families to reduce excessive salt/sodium intake among children and adolescents.

Ethical Responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World

Medical Association regarding human experimentation developed for the medical community.

Data confidentiality: The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

Rights to privacy and informed consent: The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the correspondence author.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

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