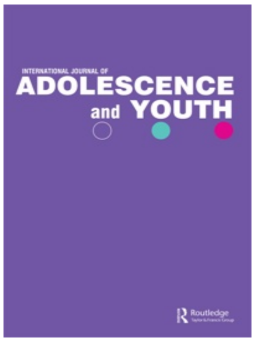

International Journal of Adolescence and Youth

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rady20

Food literacy in Venezuelan adolescents: a cross-sectional study

Jesús Enrique Ekmeiro-Salvador, Maximilian Andreas Storz & Jacinto Nebot-Bas

To cite this article: Jesús Enrique Ekmeiro-Salvador, Maximilian Andreas Storz & Jacinto Nebot-Bas (2024) Food literacy in Venezuelan adolescents: a cross-sectional study, International Journal of Adolescence and Youth, 29:1, 2358082, DOI: 10.1080/02673843.2024.2358082

To link to this article: https://doi.org/10.1080/02673843.2024.2358082

Published online: 23 May 2024.

INTERNATIONAL JOURNAL OF ADOLESCENCE AND YOUTH
2024, VOL. 29, NO. 1, 2358082
https://doi.org/10.1080/02673843.2024.2358082

Routledge
Taylor & Francis Group

OPEN ACCESS Check for updates

Food literacy in Venezuelan adolescents: a cross-sectional study

Jesús Enrique Ekmeiro-Salvador [a], Maximilian Andreas Storz [b] and Jacinto Nebot-Bas [a]

[a]Department of Food Science, University of Oriente, Puerto La Cruz, Venezuela; [b]Center for Complementary Medicine, Department of Internal Medicine II, Faculty of Medicine, University Hospital of Freiburg, University of Freiburg, Freiburg, Germany

ABSTRACT

Food literacy reflects personal behaviours around healthy eating and is an important skill for individuals to make healthy dietary choices. The present cross-sectional study investigated food literacy and the ability to identify $n = 43$ foods of plant origin in $n = 1322$ Venezuelan adolescents aged 15–17 years in the city of Puerto La Cruz, Venezuela. With only $n = 14$ correctly identified plant food items (median; IQR: 12), the performance in this sample was alarmingly poor, suggesting that food literacy in Venezuelan adolescents warrants urgent public health attention. Substantial and significant sex-specific differences were found, with an even worse performance in male adolescents. The lacking ability to correctly identify foods of plant origin has national public health implications, and constitutes an important obstacle for national strategies and dietary guidelines, which aim at improving nutrient intake in this particularly vulnerable population group.

ARTICLE HISTORY
Received 10 April 2024
Accepted 16 May 2024

KEYWORDS
Adolescent health; diet quality; food literacy; vegetables; fruits; education

Background

Epidemiological and public health research has widely documented the association between fruit and vegetable (F&V) consumption from the early stages of life with a reduced risk of chronic diseases, such as obesity, type 2 diabetes, and cardiovascular disease (Bujtor et al., 2021; Connolly et al., 2021; Liu et al., 2022; Mendes et al., 2023). A regular F&V intake promotes diversified diets and increases nutritional quality (Del Río-Celestino & Font, 2020). In 2002, the World Health Organization (WHO) established recommendations for F&V consumption (Food and Agriculture Organization of the United Nations, 2021; World Health Organization, 2024), highlighting the potential health benefits associated with an intake of at least 400 grams of F&V per day.

Nevertheless, F&V intake remains low in many parts of the world, and particularly in Latin America and the Caribbean (Hernandez-Rivas Rivas et al., 2021; Jaramillo et al., 2024; Kovalskys et al., 2019; Leyton, 2019). As such, insufficient consumption of plant foods from childhood onwards is considered a major public health problem – with serious consequences throughout life (Lock et al., 2005).

Several recent studies suggested that F&V intake in children and adolescents is even lower than expected (Gómez Salas et al., 2020; Hollis et al., 2020). While complex and multi-factorial, this phenomenon has been link to parental practices and habits, i.e. to the 'home food environment' and to physical aspects, such as the availability of foods nearby (Arévalo & Paz, 2021). The adoption of inappropriate eating behaviours in children and adolescents in Latin America is also strongly

CONTACT Maximilian Andreas Storz maximilian.storz@uniklinik-freiburg.de

Figure 1. El trompo de los alimentos = Food spinning top. **Modified from**: Food and Agriculture Organization of the United Nations. Technical documents & project reports. El trompo de los alimentos = Food Spinning Top. Food and Agriculture Organization of the United Nations (2010). https://openknowledge.fao.org/handle/20.500.14283/as878s

influenced by other environmental factors, such as the socioeconomic and sociocultural context in which children and adolescents are raised and educated (Melo et al., 2017; Zanardo et al., 2023).

Almost all countries provide their population with dietary guidelines and food pyramids with the purpose of outlining and promoting, at an individual and collective level, a healthy diet. In Venezuela, the 2007 dietary guideline called '*El Trompo de los Alimentos*' (Figure 1), elaborated by the National Institute of Nutrition (*Instituto Nacional de Nutrición* (INN)), is still in force (Instituto Nacional de Nutrición de Venezuela, 2014). These didactic materials are supposed to equip the Venezuelan population with precise recommendations and ideas to combine local and seasonal foods in the form of culturally appropriate culinary preparations.

In its pictorial form, '*El Trompo de los Alimentos*' contains five major alimentary groups, including complex carbohydrates, vegetables and fruits, proteins, sugars, and fats. Each of these groups are discussed in the written form of the guidelines (Food and Agriculture Organization of the United Nations, 2010). The dietary guidelines officially appear in school books, and the country's educational system requires all students to engage and familiarize themselves with the guideline's content. Unfortunately, this objective is mainly fulfiled in a discursive and theoretical way in schools, without any hands-on experience.

The successful implementation of these guidelines, however, depends to a large extent on previous nutritional knowledge, and on the ability to *recognize* the included food items in said guidelines. Readers who lack these crucial skills will inevitably encounter difficulties when putting the guidelines into practice, and when trying to estimate the nutritional value of the various suggested food combinations.

Many studies demonstrated that nutrition education programmes, which intend to promote and increase plant food consumption, are effective at the level of specific target groups (Braga-Pontes et al., 2022; Ekmeiro Salvador et al., 2019; Wolfenden et al., 2021). Extrapolation of these results to larger populations has not always been successful, and increasing F&V intake in adolescents remains a public health challenge in Venezuela. 'Food Well-Being' (FWB) plays an important role in this context, and is defined as the 'positive psychological, physical, emotional and social relationship between food and people at the individual and societal levels' (Block et al., 2011).

FWB can be explained through the following five components: food literacy, socialization, availability, marketing and public policy; where food literacy refers to the knowledge of nutritional information and the motivation to apply it in decisions concerning food (Silva et al., 2023). Food literacy reflects personal behaviours around healthy eating, and is an important skill for individuals to make healthy dietary choices.

Food literacy in Venezuela has been rarely examined, and data on food literacy in Venezuelan adolescents is particularly scarce. Considering the quality and the limited resources of local nutritional education programmes, Venezuelan adolescents have limited nutritional knowledge, and it remains unclear whether Venezuelan adolescents are after all familiar with the recommended plant foods in the national dietary guidelines.

To put the national dietary guidelines into practice, food literacy and plant food recognition is of utmost importance. Here, we hypothesized that Venezuelan adolescents are insufficiently equipped with this crucial skill, and examined their ability to correctly recognize plant foods in a cross-sectional study with more than 1000 participants in the city of Puerto La Cruz, Venezuela.

Methods

Study population and design

Between January 2022 and December 2023, we conducted a cross-sectional observational study in six educational units in the city of Puerto La Cruz, Venezuela. The term 'educational unit' is the Spanish textual translation of the way the Venezuelan government defines schools. Initially, nine local downtown educational units were approached, however, three of them did not consent to participate in the study. All participating educational units belonged to the public education system and were located in neighbourhoods of the lowest socioeconomic strata.

The population under study was selected because it has been hit particularly hard by the country's political, economic and social crisis, which had a negative impact on the nutritional well-being of large sectors of the population (Bull & Rosales, 2020; Da Silva, 2023). Young adolescents of both sexes between the ages of 15 and 17 years who attended the last two years of high school were considered eligible for this study. All adolescents who consented to participate in the study were recruited.

All participants were asked to answer an illustrated questionnaire in face-to-face interview sessions. As a major component of the interview, participants were asked to correctly identify foods of plant origin (see below for a detailed list). The questionnaire was presented as a PowerPoint slideshow with multiple photographs. The slideshow was presented on the screen of a tablet or portable laptop device, and included images of ten vegetables, ten fruits, eight roots/tubers/starchy vegetables, eight legumes and seven different seeds, so that the participants could orally mention their names as an exercise in food identification. A total of $n = 43$ items were shown to each participant. A nutritionist, who always accompanied the session, recorded the answers in an Excel file, and registered whether items were identified correctly or not. Participants were given 60 seconds to identify a single food item before the next picture appeared.

Pictures were displayed on a laptop with a 15.6 inch diagonal screen and a resolution of 1920 × 1080 pixels. All images were shown in colour. Laptops were used due to logistical difficulties, and because the majority of the study sites had no electricity so that bringing monitors with a larger screen or a projector was deemed unfeasible and unpractical.

Foods that are an integral part of the Venezuelan dietary guideline '*El Trompo de los Alimentos*' were selected for the PowerPoint slideshow. Only foods that were easily accessible in local grocery stores, local supermarkets and the city's central market ('*el Mercado Municipal de Puerto La Cruz*') were considered for our slideshow. The photographs shown corresponded to the following food groups/food items:

Vegetables: cucumber, squash, eggplant, broccoli, cauliflower, beet, chayote, carrot, spinach, chard.

Fruits: watermelon, melon, guava, passionfruit, plum, papaya, tamarind, nispero, soursop, pomalaca.

Roots/Tubers: potato, yucca, ocumo blanco, ocumo chino, apio, sweet potato, ñame, mapuey.

Legumes: green peas, lentils, black bean, pico blanco bean, bayo bean, barcino bean, quinchoncho, chickpeas.

Seeds: peanut, cashew, walnut, almond, sesame, linseed, chia.

Upon the food selection, we paid great attention that the selected food items were physically and economically accessible for people of the lower socioeconomic strata in a country that is going through a humanitarian-food crisis. Considering these criteria, we did not find more than eight roots/tubers available in the local markets, and so the food groups were not of equal size. In the case of seeds, for example, more than eight items could be found, but several food items were deemed too 'exotic' and too expensive, even for people with better financial resources.

We intentionally did not show fresh food items because replenishing perishable items was deemed unfeasible for a lack of financial resources and in terms of the specific harvesting seasons for some items. The fact that most study sites had no access to fresh water also led us to abandon the idea of using fresh food items.

The Scientific and Ethics Committee of the Postgraduate Course in Food Science and Engineering approved the present study on 17 May 2021 under the code MS. MCA.2021/06-C729. The study was conducted in accordance with the guidelines of the Declaration of Helsinki and data was handled with strict confidentiality. Oral consent was obtained from the participants' parents and through the teachers approving the participation of the respective adolescents in the study; emphasizing that it was an optional activity.

Statistical analysis

The statistical analysis was performed with Stata software (StataCorp (2015). Statistical Software: Release 14. College Station, TX: StataCorp LP.). Histograms were used to visualize the available data. To check for data distribution, we employed Stata's Shapiro – Wilk test. Normally distributed variables were described with their mean± SD (standard deviation). As for non-normally distributed variables, we presented medians and their corresponding interquartile ranges (IQR). Categorical variables were described as follows: number of observations (percentage).

Depending on the data distribution, parametric and non-parametric tests were used to test for statistically significant differences between males and females in continuous variables. For categorical variables, Pearson's chi-squared test and Fisher's exact test were used, where applicable. All tests were two-sided. Statistical significance was determined at $\alpha = 0.05$ for all tests.

Further to that, we ran poisson regression and negative binomial regression models to examine sex- and age-adjusted predictions for the number of correctly recognized food items. Post regression, we used Stata's margins and contrasts function as well as marginsplots to graph statistics from fitted models.

Results

The present study included $n = 1322$ adolescents with a mean age of 16.17 ± 0.84 years. Both sexes were almost equally represented in the sample (48.56% male adolescents *vs* 51.44% female adolescents). Participant's sociodemographic characteristics are shown in Table 1.

Figure 2 displays a colour-coded histogram, depicting the overall number of correctly identified plant food items by all participants. A median number of 14 food items (IQR: 12) were correctly identified in the entire sample. Significant intergroup differences were found between males (blue)

Table 1. Sociodemographic data of participants.

	Complete sample $n = 1322$	Males $n = 642$	Females $n = 680$
Age	16.17 ± 0.84	17 (1)	16.00 ± 0.79
Age groups			
15 years	$n = 367$(27.76%)	$n = 156$(24.30%)	$n = 211$(31.03%)
16 years	$n = 362$(27.38%)	$n = 105$(16.36%)	$n = 257$(37.79%)
17 years	$n = 593$(44.86%)	$n = 381$(59.35%)	$n = 212$(31.18%)

Table 1 legend: based on $n = 1322$ observations. Normally distributed data shown as mean ± SD; not normally distributed data shown as median (IQR). Percentages may not equal 100% due to rounding.

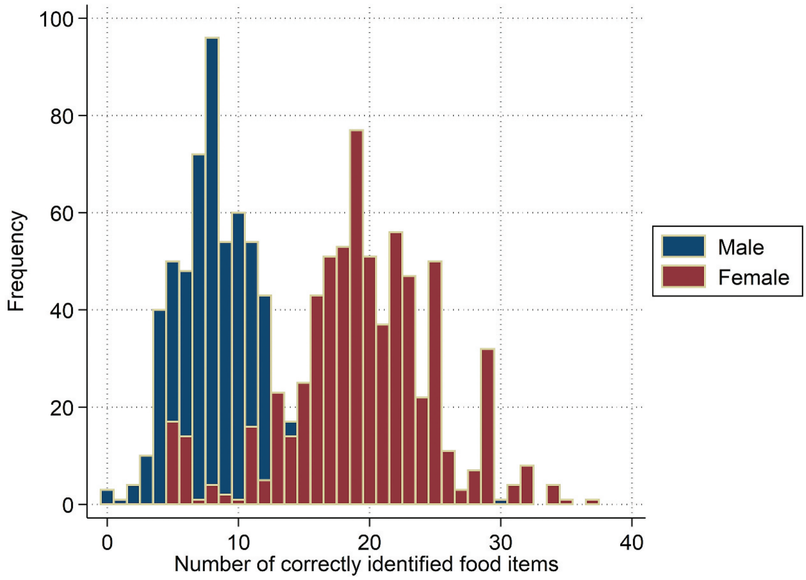

Figure 2. Colored histogram: number of correctly identified food items in the entire sample. Based on $n = 1322$ observations. Significant intergroup differences were found between male and female adolescents with regard to the median number of correctly identified food items ($p < 0.001$) as assessed by the non-parametric Mann-Whitney-Wilcoxon test.

and females (red). The median number of correctly identified food items was much lower in males ($n = 8$ (IQR: 4)) as compared to females ($n = 19$ (IQR: 6)).

Significant differences between males and females were also found when glancing at the investigated food groups. As shown in Table 2, vegetable recognition rates were consistently higher in females as compared to males. Intergroup differences were statistically significant for nearly all vegetable items ($p < 0.001$), except for the chayote. In a similar manner, Tables 3 and 4 show food recognition rates for fruits and starchy vegetables/roots/tubers, respectively. Large intergroup differences in recognition rates were found for the following fruits: plums, pomalaca, tamarind and watermelon. As for starchy vegetables/roots/tubers, 65.42% of males ($n = 420$) and 11.18% of females ($n = 76$) were unable to recognize common staples foods, such as the potato.

Some of the lowest food recognition rates were generally found for legumes (as shown in Table 5). Only 2.18% of males ($n = 14$) recognized green peas and less than 1% of males ($n = 6$) correctly recognized chickpeas. As for nuts and seeds, recognition rates were much higher in female adolescents in comparison to males (Table 6) with the exception of almonds and walnuts.

The substantial differences between males and females may also be obtained from Figure 3, which displays the percentage of participants who recognized at least one item from the examined

Table 2. Individual food recognition by sex: vegetables.

	Complete sample $n = 1322$	Males $n = 642$	Females $n = 680$	p-value
Cucumber				**$p < 0.001$ ***
No	$n = 923$(69.82%)	$n = 504$(78.50%)	$n = 419$(61.62%)	
Yes	$n = 399$(30.18%)	$n = 138$(21.50%)	$n = 261$(38.38%)	
Squash				**$p < 0.001$ ***
No	$n = 918$(69.44%)	$n = 566$(88.16%)	$n = 352$(51.76%)	
Yes	$n = 404$(30.56%)	$n = 76$(11.84%)	$n = 328$(48.24%)	
Eggplant				**$p < 0.001$ ***
No	$n = 421$(31.85%)	$n = 362$(56.39%)	$n = 59$(8.68%)	
Yes	$n = 901$(68.15%)	$n = 280$(43.61%)	$n = 621$(91.32%)	
Broccoli				**$p < 0.001$ ****
No	$n = 1229$(92.97%)	$n = 636$(99.07%)	$n = 593$(87.21%)	
Yes	$n = 93$(7.03%)	$n = 6$(0.93%)	$n = 87$(12.79%)	
Cauliflower				**$p < 0.001$ ****
No	$n = 1227$(92.81%)	$n = 638$(99.38%)	$n = 589$(86.62%)	
Yes	$n = 95$(7.19%)	$n = 4$(0.62%)	$n = 91$(13.38%)	
Beets				**$p < 0.001$ ***
No	$n = 1126$(85.17%)	$n = 575$(89.56%)	$n = 551$(81.03%)	
Yes	$n = 196$(14.83%)	$n = 67$(10.44%)	$n = 129$(18.97%)	
Chayote				$p = 0.250$**
No	$n = 1319$(99.77%)	$n = 642$(100%)	$n = 677$(99.56%)	
Yes	$n = 3$(0.23%)	$n = 0$(0%)	$n = 3$(0.44%)	
Carrot				**$p < 0.001$ ****
No	$n = 167$(12.63%)	$n = 158$(24.61%)	$n = 9$(1.32%)	
Yes	$n = 1155$(87.37%)	$n = 484$(75.39%)	$n = 671$(98.68%)	
Spinach				**$p < 0.001$ ***
No	$n = 1028$(77.76%)	$n = 587$(91.43%)	$n = 441$(64.85%)	
Yes	$n = 294$(22.24%)	$n = 55$(8.57%)	$n = 239$(35.15%)	
Chard				**$p < 0.001$ ****
No	$n = 1290$(97.58%)	$n = 639$(99.53%)	$n = 651$(95.74%)	
Yes	$n = 32$(2.42%)	$n = 3$(0.47%)	$n = 29$(4.26%)	

Table 2 legend: based on $n = 1322$ observations. * = based on Pearson's chi-squared test; ** = based on Fisher's Exact test. Significant p-values are shown in bold.

food groups. Lower recognition rates were found throughout for males as compared to females for all food groups. Intergroup differences were significant for all 5 food groups at a p-value of $p < 0.001$.

Finally, we ran a negative binomial regression model computing the adjusted predictions for the number of correctly identified food items by sex and age category. Again, substantial and significant differences were for found for both sexes as shown in the marginsplot graphically visualizing the model's results (Figure 4).

Discussion

The present study confirmed our hypothesis that Venezuelan adolescents are insufficiently equipped with the skill to reliably identify foods of plant origin, and also revealed substantial sex-specific differences. With only 14 correctly identified plant food items (median; IQR: 12), the performance of the entire sample was rather poor. Our results suggest that the majority of adolescents in the examined sample require more and better attention when it comes to the formative contexts of food literacy.

The substantial differences in plant food recognition rates between males and females could be largely attributable to gender roles associated with food preparation and consumption both locally and internationally (McKenzie et al., 2022; Ortega-Ibarra & Ortega-Ibarra, 2020; United Nations, 2024). Venezuelan women continue to be disproportionally responsible for the family food dimension; therefore, girls and female adolescents are probably more exposed to the processes of food selection, shopping and preparation from an early age, acquiring more knowledge and routine than their male counterparts. Similarly, in Latin

Table 3. Individual food recognition by sex: fruits.

	Complete sample $n = 1322$	Males $n = 642$	Females $n = 680$	p-value
Watermelon				$\mathbf{p < 0.001}$ *
No	$n = 265$(20.05%)	$n = 254$(39.56%)	$n = 11$(1.62%)	
Yes	$n = 1057$(79.95%)	$n = 388$(60.44%)	$n = 669$(98.38%)	
Melon				$\mathbf{p < 0.001}$ *
No	$n = 1118$(84.57%)	$n = 581$(90.50%)	$n = 537$(78.97%)	
Yes	$n = 204$(15.43%)	$n = 61$(9.50%)	$n = 143$(21.03%)	
Guava				$\mathbf{p < 0.001}$ *
No	$n = 645$(48.79%)	$n = 361$(56.23%)	$n = 284$(41.76%)	
Yes	$n = 677$(51.21%)	$n = 281$(43.77%)	$n = 396$(58.24%)	
Passionfruit				$\mathbf{p < 0.001}$ *
No	$n = 963$(72.84%)	$n = 509$(79.28%)	$n = 454$(66.76%)	
Yes	$n = 359$(27.16%)	$n = 133$(20.72%)	$n = 226$(33.24%)	
Plum				$\mathbf{p < 0.001}$ *
No	$n = 694$(52.50%)	$n = 556$(86.60%)	$n = 138$(20.29%)	
Yes	$n = 628$(47.50%)	$n = 86$(13.40%)	$n = 542$(79.71%)	
Papaya				$\mathbf{p < 0.001}$ *
No	$n = 193$(14.60%)	$n = 153$(23.83%)	$n = 40$(5.88%)	
Yes	$n = 1129$(85.40%)	$n = 489$(76.17%)	$n = 640$(94.12%)	
Tamarind**				$\mathbf{p < 0.001}$ *
No	$n = 832$(62.98%)	$n = 592$(92.36%)	$n = 240$(35.29%)	
Yes	$n = 489$(37.02%)	$n = 49$(7.64%)	$n = 440$(64.71%)	
Nispero				$\mathbf{p < 0.001}$ *
No	$n = 1118$(84.57%)	$n = 596$(92.83%)	$n = 522$(76.76%)	
Yes	$n = 204$(15.43%)	$n = 46$(7.17%)	$n = 158$(23.24%)	
Soursop				$\mathbf{p < 0.001}$ *
No	$n = 1012$(76.55%)	$n = 558$(86.92%)	$n = 454$(66.76%)	
Yes	$n = 310$(23.45%)	$n = 84$(13.08%)	$n = 226$(33.24%)	
Pomalaca				$\mathbf{p < 0.001}$ *
No	$n = 427$(32.30%)	$n = 325$(50.62%)	$n = 102$(15.00%)	
Yes	$n = 895$(67.70%)	$n = 317$(49.38%)	$n = 578$(85.00%)	

Table 3 legend: based on $n = 1322$ observations. * = based on Pearson's chi-squared test; ** = based on $n = 1321$ observations. Significant p-values are shown in bold.

America and the Caribbean, the formation of families with multiple children, as well as the high frequency of teenage pregnancies, often forces young girls and adolescents to assume food responsibilities from early on (Arias-Rodríguez et al., 2023; Pan American Health Organization, 2020).

In addition to that, young girls and adolescents are frequently exposed to immense social pressures and expected norms with regard to their physical appearance, valuing physical appearance (e.g. the slimness ideal) over health, which undoubtedly influences them to approach the food issue in a different way than boys and male adolescents (Cassi & Pedrón, 2022; Das & Mishra, 2021).

The overall poor performance of the study sample did not surprise us, and is indirectly in accordance with the numerous national and international studies that reported a limited intake of vegetables in adolescents (Paini & Kirsten, 2021; Perdomo et al., 2022; Wever et al., 2021; Yuan et al., 2022). Nevertheless, the very low recognition rates in our sample for some rather common plant foods ubiquitously available in local markets leads us to reflect not only about the systemic causes of this indicator of food illiteracy, but also about the challenge of reversing this situation in the mid- and long-term. Data on how study participants were involved in the daily food preparation processes at home would have allowed for some important additional insights into these questions but was unfortunately not captured in the study. Then again, in the midst of a humanitarian food crisis in Venezuela, access to food is generally difficult, and families do not prioritize the purchase of vegetables and fruits when they go to the market. Even if adolescents participated in the preparation of meals at home, they would still not have a large number of vegetables and fruits to choose from (Hernandez-Rivas Rivas et al., 2021; Vera et al., 2020).

Table 4. Individual food recognition by sex: starchy vegetables/roots/tubers.

	Complete sample $n = 1322$	Males $n = 642$	Females $n = 680$	*p*-value
Potato				**$p < 0.001$ ***
No	$n = 496(37.52\%)$	$n = 420(65.42\%)$	$n = 76(11.18\%)$	
Yes	$n = 826(62.48\%)$	$n = 222(34.58\%)$	$n = 604(88.82\%)$	
Yucca				**$p < 0.001$ ****
No	$n = 40(3.03\%)$	$n = 40(6.23\%)$	$n = 0(0\%)$	
Yes	$n = 1282(96.97\%)$	$n = 602(97.77\%)$	$n = 680(100\%)$	
OcumoBlanco				**$p < 0.001$ ***
No	$n = 1159(87.67\%)$	$n = 628(97.82\%)$	$n = 531(78.09\%)$	
Yes	$n = 163(12.33\%)$	$n = 14(2.18\%)$	$n = 149(21.91\%)$	
Ocumo Chino				**$p < 0.001$ ***
No	$n = 455(34.42\%)$	$n = 315(49.07\%)$	$n = 140(20.59\%)$	
Yes	$n = 867(65.58\%)$	$n = 327(50.93\%)$	$n = 540(79.41\%)$	
Apio				**$p < 0.001$ ****
No	$n = 1169(88.43\%)$	$n = 635(98.91\%)$	$n = 534(78.53\%)$	
Yes	$n = 153(11.57\%)$	$n = 7(1.09\%)$	$n = 146(21.47\%)$	
Sweet potato				**$p < 0.001$ ***
No	$n = 772(58.40\%)$	$n = 469(73.05\%)$	$n = 303(44.56\%)$	
Yes	$n = 550(41.60\%)$	$n = 173(36.95\%)$	$n = 377(55.44\%)$	
Mapuey				$p = 0.140$*
No	$n = 1291(97.66\%)$	$n = 631(98.29\%)$	$n = 660(97.06\%)$	
Yes	$n = 31(2.34\%)$	$n = 11(1.71\%)$	$n = 20(2.94\%)$	

Table 4 legend: based on $n = 1322$ observations. * = based on Pearson's chi-squared test; ** = based on Fisher's Exact test. Significant p-values are shown in bold.

Table 5. Individual food recognition by sex: legumes.

	Complete sample $n = 1322$	Males $n = 642$	Females $n = 680$	*p*-value
Green peas				**$p < 0.001$ ***
No	$n = 1209(91.45\%)$	$n = 628(97.82\%)$	$n = 581(85.44\%)$	
Yes	$n = 113(8.55\%)$	$n = 14(2.18\%)$	$n = 99(14.56\%)$	
Lentils				**$p < 0.001$ ***
No	$n = 545(41.23\%)$	$n = 448(69.78\%)$	$n = 97(14.26\%)$	
Yes	$n = 777(58.77\%)$	$n = 194(30.22\%)$	$n = 583(85.74\%)$	
Black beans				**$p < 0.001$ ****
No	$n = 55(4.16\%)$	$n = 54(8.41\%)$	$n = 1(0.15\%)$	
Yes	$n = 1267(95.84\%)$	$n = 588(91.59\%)$	$n = 679(99.85\%)$	
Picco blanco beans				**$p < 0.001$ ***
No	$n = 855(64.67\%)$	$n = 529(82.40\%)$	$n = 326(47.94\%)$	
Yes	$n = 467(35.33\%)$	$n = 113(17.60\%)$	$n = 354(52.06\%)$	
Barcino beans				**$p < 0.001$ ****
No	$n = 1201(90.85\%)$	$n = 619(96.42\%)$	$n = 582(85.59\%)$	
Yes	$n = 121(9.15\%)$	$n = 23(3.58\%)$	$n = 98(14.41\%)$	
Quinchoncho				**$p < 0.001$ ***
No	$n = 555(41.98\%)$	$n = 355(55.30\%)$	$n = 200(29.41\%)$	
Yes	$n = 767(58.02\%)$	$n = 287(44.70\%)$	$n = 480(70.59\%)$	
Chickpea				**$p < 0.001$ ****
No	$n = 1257(95.08\%)$	$n = 636(99.07\%)$	$n = 621(91.32\%)$	
Yes	$n = 65(4.92\%)$	$n = 6(0.93\%)$	$n = 59(8.68\%)$	

Table 5 legend: based on $n = 1322$ observations. * = based on Pearson's chi-squared test; ** = based on Fisher's Exact test. Significant p-values are shown in bold.

There are no doubts about the benefits of consuming F&V, and the position of the WHO and other international organizations has been clear in establishing daily intake recommendation (Lange et al., 2021; World Health Organization, 2024), which are particularly critical in this population group of adolescents as they are going through a stage of life characterized by physical growth and development, demanding a large amount of energy, minerals, vitamins, dietary fibre and unsaturated fatty acids abundantly present in plant foods. The obtained results also suggest a poor diet quality in the examined adolescents, assuming a likely relationship between their lack of knowledge of most plant-

Table 6. Individual food recognition by sex: nuts and seeds.

	Complete sample $n = 1322$	Males $n = 642$	Females $n = 680$	*p*-value
Peanut				$\mathbf{p < 0.001}$ *
No	$n = 858(64.90\%)$	$n = 520(81.00\%)$	$n = 338(49.71\%)$	
Yes	$n = 464(35.10\%)$	$n = 122(19.00\%)$	$n = 342(50.29\%)$	
Cashew				$\mathbf{p < 0.001}$ *
No	$n = 731(55.30\%)$	$n = 515(80.22\%)$	$n = 216(31.76\%)$	
Yes	$n = 591(44.70\%)$	$n = 127(19.78\%)$	$n = 464(68.24\%)$	
Walnut				$p = 0.514$**
No	$n = 1321(99.92\%)$	$n = 642(100\%)$	$n = 679(99.85\%)$	
Yes	$n = 1(0.08)$	$n = 0(100\%)$	$n = 1(0.15\%)$	
Almond				-
No	$n = 1322(100\%)$	$n = 642(100\%)$	$n = 680(100\%)$	
Yes	$n = 0(0\%)$	$n = 0(0\%)$	$n = 0(0\%)$	
Sesame				$\mathbf{p < 0.001}$ *
No	$n = 1078(81.54\%)$	$n = 617(96.11\%)$	$n = 461(67.79\%)$	
Yes	$n = 244(18.46\%)$	$n = 25(3.89\%)$	$n = 219(32.21\%)$	
Linseed				$\mathbf{p < 0.001}$ *
No	$n = 858(64.90\%)$	$n = 600(93.46\%)$	$n = 258(37.94\%)$	
Yes	$n = 464(35.10\%)$	$n = 42(6.54\%)$	$n = 422(62.06\%)$	
Chia				$\mathbf{p < 0.001}$ **
No	$n = 1262(95.46\%)$	$n = 633(98.60\%)$	$n = 629(92.50\%)$	
Yes	$n = 60(4.54\%)$	$n = 9(1.40\%)$	$n = 51(7.50\%)$	

Table 6 legend: based on $n = 1322$ observations. * = based on Pearson's chi-squared test; ** = based on Fisher's Exact test. Significant p-values are shown in bold.

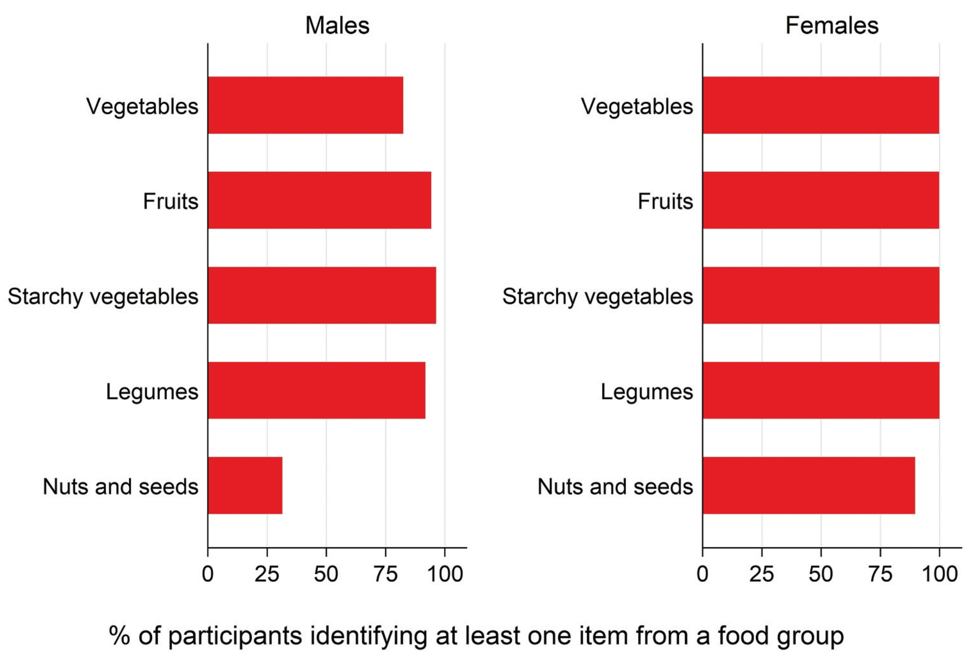

Figure 3. Food group recognition by sex category: percentage of participants who recognized at least one item from the respective food group. Based on $n = 1322$ observations. Intergroup differences were significant for all 5 food groups based on Fisher's Exact test (used for all items excepts 'nuts and seeds') and Pearson's chi-squared test (used for 'nuts and seeds') at a p-value of $p < 0.001$.

based foods and a limited consumption of the latter within their families. A reservation must be made, however, that nutrient and food intake data itself were not captured, which limits the overall significance of the study. The assumption that a low identification rate of plant foods implies and

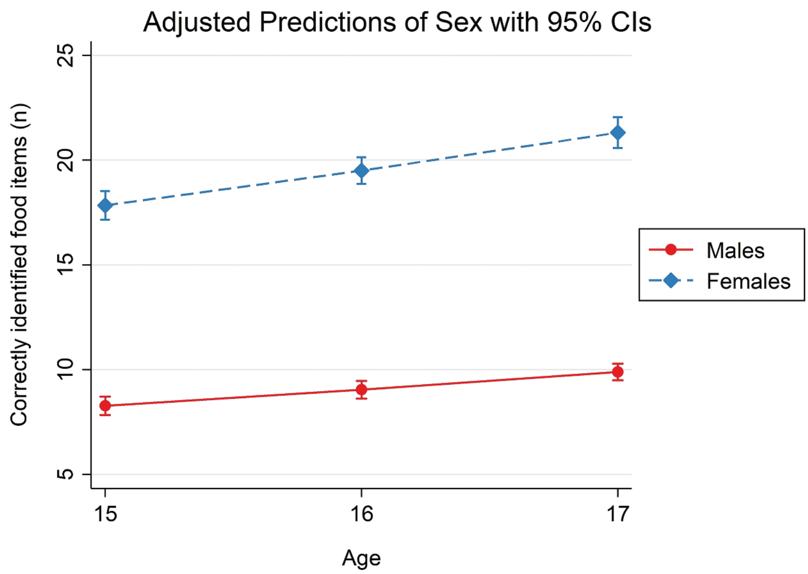

Figure 4. Marginsplots displaying the number of correctly identified food items. Adjusted predictions based on a negative binomial regression models considering age and sex.

translates into an actual low intake of plant foods may actually not be proven by the study design, although an association between both is very much conceivable.

Further to that, the socio-political and economic context that Venezuela has been going through in the last decade may be another explaining element. Subsequent to an ongoing and prolonged domestic crisis, it has been reported that most families have significantly reduced their consumption of plant-based foods, often due to a limited financial scope to purchase F&V (Hernandez-Rivas Rivas et al., 2021). Instead of purchasing expensive fruits and vegetables, many people prioritize staple foods, such as cereals (rice, pasta) in combination with some other sources of protein, such as ground beef or hard cheeses, which can be grated into small portions. At present, the daily loss of purchasing power makes fruits and vegetables more expensive than buying a bottle of soda. Similarly, the electricity and gas crisis (leading to frequent supply interruptions) makes the preparation of legumes difficult, as most of them have a long boiling time while constant energy supply may not be guaranteed. The low intake of F&V in adolescents is thus likely multifactorial, and not the result of a single cause (Sainz-Borgo, 2019).

This general context of the country undoubtedly also affected the educational system, probably preventing school food programmes from offering a wide variety of vegetables, fruits, tubers, legumes and grains to broaden the food horizon of school children and adolescents. A substantial impact on teachers and educational staff is also conceivable, who are potentially unfamiliar with several plant foods that are difficult for them to access economically. This provides a new venue for further studies on food literacy, investigating the skills of teachers, as well as the quality of the diet currently offered by school canteens in Venezuela.

Food literacy is essential in numerous scenarios beyond school education, as young people are particularly exposed to the influences of ultra-processed foods, which are often sold as an ‘identity element’ for this age group (Hernandez-Rivas Rivas et al., 2021). Extraordinarily aggressive advertising campaigns aimed at adolescents mainly through social networks appear to be common in Venezuela these days, promoting with great success the consumption of cheap and ubiquitously accessible industrial beverages and processed food with little no nutritional value (Ekmeiro-Salvador & Matos-Lopez, 2022). Such products are readily available in and around schools, with a potentially devastating impact on adolescents. Junk food not only implies an inadequate economic investment in products of little nutritional value but also focuses the attention of young people, whose consumption habits are in full formation, on satisfying hunger quickly, distracting them from other more appropriate dietary options contributing in a more favourable way to their growth period, such as foods of plant origin (Pathak et al., 2024).

Nutrition literacy implies an enormous challenge, since many of the areas of influence require political control structures (advertising regulation, junk food at school) (Amorim et al., 2022; Popkin, 2006) long-term training in a context lacking economic resources, and to a large extent the development of self-control mechanisms in individuals at particular risk. It is inherently difficult for someone to consume a food which they cannot name and thus not identify. Therefore, our discussion highlights the need to prioritize strategies for learning to identify foods of plant origin as a priority in nutrition education programmes. The current Venezuelan dietary guidelines propose a didactic of transmitting knowledge about foods which most adolescents do not even recognize. As a corollary, their effectiveness ends up being very limited in terms of improving the diet quality of adolescents.

Although there may be governmental strategies to facilitate the population's access to more plant-based foods, such as food assistance programmes, perhaps the school, to a greater extent than the home, is the appropriate setting to create the educational scaffolding required by young people to internalize the consumption of plant-based foods. At school, learners can access and empower themselves with communication tools such as language and critical reflection, to achieve cognitive transformation through the understanding and internalization of these foods as new symbols and cultural signs (Ekmeiro Salvador et al., 2019). In this way, the school can continue to fulfil its broad educational function, beyond the limited context of family education.

In this sense, improving the food vocabulary of young people is deemed as a pre-requisite to any nutrition education intervention. Easier said than done, such an objective may not be realized with theoretical exercises and vocabulary tests, and should employ a skill-based and 'hands-on approach' going beyond 'unattainable' foods which adolescents do not physically know and which are not part of their diet both at school and at home (Fredericks et al., 2020; Simbar et al., 2022). Finally, such a nutritional extension should involve the entire educational community, especially teachers, to help reinforce new eating behaviours from their sociocultural environment.

To the best of our knowledge, this is one of the first and largest studies to examine plant food recognition and food literacy in Venezuelan adolescents. The findings and message are of utmost public health importance, despite the rather simple study methodology. Strengths include the rather large sample size, the standardized methodology and the study's extent, which is hard to realize in a country suffering from ongoing economic constraints and limited financial resources for scientific investigations. Weaknesses included the limited number of sociodemographic variables describing the study sample (which is essentially limited to age and sex) as well as the lack of a nutrient intake assessment. The latter was not feasible for a lack of financial resources but would have certainly enriched our study. Although the sample is large, it is confined to a single city in the country and could be extended to other cities in other regions in the future to compare results. Similarly, we worked only with young people in free public education, from lower socioeconomic strata, so it would be interesting to extend the study to the same population of the non-free private school system, which is attended by the more privileged classes. Another limitation is that only adolescents aged 15–17 years were included in the study. Although we were interested in early adolescence, as well, we regrettably did not have sufficient funding to expand the study to other age groups. The investigated age group (15–17 years) appeared most attractive to us because, according to local data, most of these adolescents may not aim for a higher education degree due to their limited financial resources. Thus, this age group presumably represents the level of food literacy of a greater part of the country's population.

Nevertheless, despite these limitations, we deem our results to be important and hope to draw the attention of involved national stakeholders and political entities.

Conclusions

Our results highlight the importance of food literacy as a premise for the efficiency of any educational intervention. Adolescents in the examined sample lacked the skill to identify foods of plant origin, which constitutes an obstacle to progress in terms of strategies and content aimed at improving practices related to dietary quality. Official tools, such as the national dietary guidelines, appear inadequate for these individuals without the ability to handle the elements proposed by these learning methods. It is thus imperative to rethink the strategies proposed in Venezuelan nutrition education programmes, which are ought to consider the level of food literacy of its target population.

The seriousness of the problem to identify foods of plant origin indirectly predicts in a certain way the diet quality of the examined participants, where native tubers, local fruits, vegetables, legumes and traditional seeds do not seem to play an important role. The potentially associated loss in nutritional value appears of particular concern. Adding plant foods on a regular basis could be a powerful tool to mitigate the food crisis Venezuela is currently going through.

Acknowledgments

This work been approved by all co-authors.

We would like to express our deep gratitude to Professor Cruz Rafael Arevalo-Vera, from the Universidad de Oriente, who inspired us with his impressive community work and helped us define the objectives of this research.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The authors received no financial support/funding. Open access publishing enabled by Freiburg University Open Access Funding.

ORCID

Jesús Enrique Ekmeiro-Salvador http://orcid.org/0000-0002-9518-6332
Maximilian Andreas Storz http://orcid.org/0000-0003-3277-0301
Jacinto Nebot-Bas http://orcid.org/0009-0004-8727-9450

Authors' contributions

Conceptualization: J.´.E. and J.N.; Data curation: J.´.E. and J.N.; Formal analysis: J.´.E. and M.A.S.; Funding acquisition: M.A. S.; Investigation: J.´.E., M.A.S. and J.N.; Methodology: J.´.E. and J.N.; Project administration: J.´.E.; Resources: J.´.E., M.A. S. and J.N.; Software: M.A.S.; Supervision: J.´.E., M.A.S. and J.N.; Validation: J.´.E., M.A.S. and J.N.; Visualization: M.A.S.; Writing – original draft: J.´.E. and M.A.S.; Writing – review & editing: J.´.E., M.A.S. and J.N.

Data availability statement

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Oral consent was obtained from the participants' parents and through the teachers approving the participation of the respective adolescents in the study; emphasizing that it was an optional activity.

Ethics approval and consent to participate

The Scientific and Ethics Committee of the Postgraduate Course in Food Science and Engineering approved the present study on 17 May 2021 under the code MS. MCA.2021/06-C729. The study was conducted in accordance with the guidelines of the Declaration of Helsinki and data was handled with strict confidentiality.

References

Amorim, A., Laurindo, J. B., & Sobral, P. J. D. A. (2022). On how people deal with industrialized and non-industrialized food: A theoretical analysis. *Frontiers in Nutrition*, *9*. https://doi.org/10.3389/fnut.2022.948262

Arévalo, M. T. V., & Paz, F. M. (2021). Aspectos físicos y sociales del ambiente alimentario del hogar relacionados con el consumo de frutas y verduras en niños escolares: Un estudio transversal [Physical and social aspects of the home food environment related to the fruits and vegetables consumption in school children: A cross-sectional study]. *Revista Española de Nutrición Humana y Dietética*, *25*(2), Article 2. https://doi.org/10.14306/renhyd.25.2.1092

Arias-Rodríguez, F. D., Michilena, M. M. P., Ruiz, M. D. L. Á. B., Llosa, S. J., Román, L. K. M., López, M. J. N., Jácome, L. A. S., & Jácome, K. R. R. (2023). Embarazo adolescente en Ecuador y América Latina: Un grave problema de salud pública [Adolescent pregnancy in Ecuador and Latin America: A serious public health problem]. *Revista del Instituto de Salud Pública de Chile*, *7*(2), Article 2. https://doi.org/10.34052/rispch.v7i2.181

Block, L. G., Grier, S. A., Childers, T. L., Davis, B., Ebert, J. E. J., Kumanyika, S., Laczniak, R. N., Machin, J. E., Motley, C. M., Peracchio, L., Pettigrew, S., Scott, M., & Bieshaar, M. N. G. G. (2011). From nutrients to nurturance: A conceptual introduction to food well-being. *Journal of Public Policy & Marketing*, *30*(1), 5–13. https://doi.org/10.1509/jppm.30.1.5

Braga-Pontes, C., Simões-Dias, S., Lages, M., Guarino, M. P., & Graça, P. (2022). Nutrition education strategies to promote vegetable consumption in preschool children: The Veggies4myHeart project. *Public Health Nutrition*, *25*(4), 1061–1070. https://doi.org/10.1017/S1368980021004456

Bujtor, M., Turner, A. I., Torres, S. J., Esteban-Gonzalo, L., Pariante, C. M., & Borsini, A. (2021). Associations of dietary intake on biological markers of inflammation in children and adolescents: A systematic review. *Nutrients*, 13(2), Article 2. https://doi.org/10.3390/nu13020356

Bull, B., & Rosales, A. (2020). The crisis in Venezuela: Drivers, transitions, and pathways. *European Review of Latin American and Caribbean Studies*, *0*(109), 109. Article 109. https://doi.org/10.32992/erlacs.10587

Cassi, C. F., & Pedrón, V. T. (2022). Asociaciones entre los estereotipos de género tradicionales y los trastornos de la conducta alimentaria durante la adolescencia y juventud. Una revisión sistemática. [Associations between tradiccional gender stereotype and eating disorders during adolescence and youth. A systematic review]. *Psicología del desarrollo*, 3, Article 3. https://doi.org/10.59471/psicologia20221

Connolly, E. L., Sim, M., Travica, N., Marx, W., Beasy, G., Lynch, G. S., Bondonno, C. P., Lewis, J. R., Hodgson, J. M., & Blekkenhorst, L. C. (2021). Glucosinolates from cruciferous vegetables and their potential role in chronic disease: Investigating the preclinical and clinical evidence. *Frontiers in Pharmacology*, *12*, 767975. https://doi.org/10.3389/fphar.2021.767975

Da Silva, G. (2023, Septrmber 28). Venezuela's crisis: A multifaceted examination of economic, political, and humanitarian challenges. *International Journal of Science and Society*. Retrieved April 6, 2024, from https://ijsoc.goacademica.com/index.php/ijsoc/article/view/821

Das, S., & Mishra, A. J. (2021). Dietary practices and gender dynamics: Understanding the role of women. *Journal of Ethnic Foods*, *8*(1), 4. https://doi.org/10.1186/s42779-021-00081-9

Del Río-Celestino, M., & Font, R. (2020). The health benefits of fruits and vegetables. *Foods (Basel, Switzerland)*, *9*(3), 369. https://doi.org/10.3390/foods9030369

Ekmeiro-Salvador, J. E., & Matos-Lopez, J. M. (2022). Cultura Alimentaria. Una revisión conceptual [Food Culture. A conceptual review]. *Anales Venezolanos de Nutrición*, *35*(2), 117–126. https://doi.org/10.54624/2022.35.2.005

Ekmeiro Salvador, J., Moreno Rojas, R., & Cámara Martos, F. (2019). Educación nutricional desde entornos socioconstructivistas: Influencia sobre el patrón de consumo de alimentos en comunidades venezolanas [Nutrition education from socioconstructivist environments: Influence on the pattern of food consumption in Venezuelan communities]. *Nutrición Clínica y Dietética Hospitalaria*, *39*(4), 94–104. https://doi.org/10.12873/3943moreno

Food and Agriculture Organization of the United Nations. (2010). *Technical documents & project reports. El trompo de los alimentos = Food spinning top*. https://openknowledge.fao.org/handle/20.500.14283/as878s

Food and Agriculture Organization of the United Nations. (2021). *Fruits and veg*etables *- your dietary essentials* [Internet]. Retrieved March 29, 2024, from https://www.fao.org/3/cb2395en/online/cb2395en.html

Fredericks, L., Koch, P. A., Liu, A. A., Galitzdorfer, L., Costa, A., & Utter, J. (2020). Experiential features of culinary nutrition education that drive behavior change: Frameworks for research and practice. *Health Promotion Practice*, *21*(3), 331–335. https://doi.org/10.1177/1524839919896787

Gómez Salas, G., Quesada, D., Chinnock, A., Gómez Salas, G., Quesada, D., & Chinnock, A. (2020). Consumo de frutas y vegetales en la población urbana costarricense: Resultados del Estudio Latino Americano de Nutrición y Salud (ELANS)-Costa Rica [Fruits and vegetables intake among Costa Rican urban population: Results from the Latin American Study of Nutrition and Health: ELANS-Costa Rica]. *Población y Salud en Mesoamérica*, *18*(1), 450–470. https://doi.org/10.15517/psm.v18i1.42383

Hernandez-Rivas Rivas, P. I., Ramírez, G., Vasquez, M., & Herrera-Cuenca, M. (2021). Patrones de consumo de frutas y hortalizas en la población urbana de Venezuela [Fruit and vegetable consumption patterns in the Venezuelan urban population]. *Revista Española de Nutrición Humana y Dietética*, 25(2), Article 2. https://doi.org/10.14306/renhyd.25.2.1100

Hollis, J. L., Collins, C. E., DeClerck, F., Chai, L. K., McColl, K., & Demaio, A. R. (2020). Defining healthy and sustainable diets for infants, children and adolescents. *Global Food Security*, *27*, 100401. https://doi.org/10.1016/j.gfs.2020.100401

Instituto Nacional de Nutrición de Venezuela. El trompo de los alimentos. (2014). Retrieved March 29, 2024, from https://www.inn.gob.ve/innw/wpcontent/uploads/2014/02/Trompo_de_los_Alimentos.pdf

Jaramillo, V. L. M., Sinche, M. E. V., & Condoy, K. E. B. (2024). Consumo de frutas—Verduras y estado nutricional en adjudicatarios del mercado municipal Gran Colombia de la ciudad de Loja [Consumption of fruits -vegetables and nutritional status in beneficiaries of the Gran Colombia municipal market in the city of Loja]. *Ibero-American Journal of Health Science Research*, 4(1), Article 1. https://doi.org/10.56183/iberojhr.v4i1.602

Kovalskys, I., Rigotti, A., Koletzko, B., Fisberg, M., Gómez, G., Herrera-Cuenca, M., Cortés Sanabria, L. Y., Yépez García, M. C., Pareja, R. G., Zimberg, I. Z., Del Arco, A., Zonis, L., Previdelli, A. N., Guajardo, V., Moreno, L. A., Fisberg, R., & Vellakkal, S. (2019). Latin American consumption of major food groups: Results from the ELANS study. *PLOS ONE*, *14*(12), e0225101. https://doi.org/10.1371/journal.pone.0225101

Lange, S. J., Moore, L. V., Harris, D. M., Merlo, C. L., Lee, S. H., Demissie, Z., & Galuska, D. A. (2021). Percentage of adolescents meeting federal fruit and vegetable intake recommendations—youth risk behavior surveillance system, United States, 2017. *MMWR Morbidity and Mortality Weekly Report*, *70*(3), 69–74. https://doi.org/10.15585/mmwr.mm7003a1

Leyton, M. R. (2019). Desafíos para el consumo de frutas y verduras: Challenges for the consumption of fruits and vegetables. *Revista de la Facultad de Medicina Humana*, *19*(2), Article 2. https://doi.org/10.25176/RFMH.v19.n2.2077

Liu, J., Li, Y., Wang, X., Gao, D., Chen, L., Chen, M., Ma, T., Ma, Q., Ma, Y., Zhang, Y., Jiang, J., Zou, Z., Wang, X., Dong, Y., & Ma, J. (2022). Association between fruit consumption and lipid profile among children and adolescents: A national cross-sectional study in China. *Nutrients*, *14*(1), Article 1. https://doi.org/10.3390/nu14010063

Lock, K., Pomerleau, J., Causer, L., Altmann, D. R., & McKee, M. (2005). The global burden of disease attributable to low consumption of fruit and vegetables: Implications for the global strategy on diet. *Bulletin of the World Health Organization*, *83*(2), 100–108.

McKenzie, B. L., Waqa, G., Hart, A. C., Moala Silatolu, A., Palagyi, A., Norton, R., McLean, R., & Webster, J. (2022). Gender roles, generational changes and environmental challenges: An intersectional interpretation of perceptions on healthy diets among iTaukei women and men in Fiji. *Public Health Nutrition*, *25*(11), 3146–3157. https://doi.org/10.1017/S1368980022001677

Melo, R. B. D., Dorow, R., Finocchio, C. P. S., & Feitosa, T. B. (2017). Economias em desenvolvimento e o Consumo de Frutas e Hortaliças [Developing economies and consumption of fruits and vegetables]. *Revista Semiárido De Visu*, 4 (3), Article 3.

Mendes, V., Niforou, A., Kasdagli, M. I., Ververis, E., & Naska, A. (2023). Intake of legumes and cardiovascular disease: A systematic review and dose-response meta-analysis. *Nutrition, Metabolism, and Cardiovascular Diseases: NMCD*, *33* (1), 22–37. https://doi.org/10.1016/j.numecd.2022.10.006

Ortega-Ibarra, I. H., & Ortega-Ibarra, E. (2020). La transformación en la cultura alimentaria con enfoque de género [The transformation in the food culture with a gender approach. *Rednutricion]*, *11*(1), 698–700.

Paini, D., & Kirsten, V. R. (2021). Frequência e fatores associados ao consumo de frutas, verduras e legumes de adolescentes. *Saúde e Pesquisa*, *14*(Supl. 1), 1–13. Article (Supl. 1). https://doi.org/10.17765/2176-9206.2021v14Supl.1.e9029

Pan American Health Organization. (2020, August). Adolescent pregnancy in Latin America and the Caribbean. *Technical Brief*. https://iris.paho.org/handle/10665.2/53133

Pathak, S., Baral, A., & Adhikari, B. P. (2024). Factors influencing undergraduate students' motivation for junk food. *OCEM Journal of Management, Technology & Social Sciences*, *3*(1), 5–17. https://doi.org/10.3126/ocemjmtss.v3i1.62208

Perdomo, P. B., Vásquez, H. A., Silva, E., Bermudez, G., & González, L. (2022). Estado de salud cardiovascular y dieta saludable en adolescentes de maracaibo. *Enfermería Investiga*, *7*(3), 12–22. https://doi.org/10.31243/ei.uta.v7i3.1678.2022

Popkin, B. M. (2006). Global nutrition dynamics: The world is shifting rapidly toward a diet linked with noncommunicable diseases. *The American Journal of Clinical Nutrition*, *84*(2), 289–298. https://doi.org/10.1093/ajcn/84.2.289

Sainz-Borgo, C. (2019, September 16). *Encuesta de hábitos alimentarios de estudiantes de la licenciatura de biología, Universidad Simón Bolívar, Caracas, Venezuela [Survey of eating habits of students of Biology, Universidad Simon Bolivar, Caracas, Venezuela]* (Vol. 31, pp. 294–304). SABER.

Silva, P., Araújo, R., Lopes, F., & Ray, S. (2023). Nutrition and food literacy: Framing the challenges to health communication. *Nutrients*, *15*(22), 4708. https://doi.org/10.3390/nu15224708

Simbar, M., Nazarpour, S., Arabi, Z., Keshavarz, Z., & Baghestani, A. R. (2022). Skills-based education for promoting healthy diet among female adolescents: A randomized controlled trial study. *Child & Adolescent Social Work Journal*, *39*(1), 87–95. https://doi.org/10.1007/s10560-020-00696-y

StataCorp. (2015). *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LLC.

United Nations. (2024, March 29). Gender inequality in food and agriculture costs the world $1 trillion. *UN News*. https://news.un.org/es/story/2023/04/1520097

Vera, Y., Jardim, K., Carreño, L., & Landaeta-Jiménez, M. (2020). Aproximación a la alimentación y nutrición en dos comunidades pobres de Venezuela [Approach to food and nutrition in two poor communities in eastern Venezuela]. *Anales Venezolanos de Nutrición*, *33*(2), 133–140.

Wever, N. D., Mogollón, H. H., Fajardo, Z., & Chinchilla, A. G. (2021). Consumo de macronutrientes y micronutrientes en adolescents [Intake of macronutrients and micronutrients in adolescents]. *TAYACAJA*, *4*(1), 180–192. https://doi.org/10.46908/tayacaja.v4i1.163

Wolfenden, L., Barnes, C., Lane, C., McCrabb, S., Brown, H. M., Gerritsen, S., Barquera, S., Véjar, L. S., Munguía, A., & Yoong, S. L. (2021). Consolidating evidence on the effectiveness of interventions promoting fruit and vegetable consumption: An umbrella review. *International Journal of Behavioral Nutrition and Physical Activity*, *18*(1), 11. https://doi.org/10.1186/s12966-020-01046-y

World Health Organization. (2024, March 29). *Increasing fruit and vegetable consumption to reduce the risk of noncommunicable diseases* [Internet]. https://www.who.int/tools/elena/commentary/fruit-vegetables-ncds

Yuan, L., Muli, S., Huybrechts, I., Nöthlings, U., Ahrens, W., Scalbert, A., & Floegel, A. (2022). Assessment of fruit and vegetables intake with biomarkers in children and adolescents and their level of validation: A systematic review. *Metabolites*, *12*(2), 126. https://doi.org/10.3390/metabo12020126

Zanardo, M. L. R., Fonseca, G. S. D., & Gomes, C. D. B. (2023). Da cor da pele ao consumo de frutas, verduras e legumes: Insegurança Alimentar e suas associações [From skin color to fruit, vegetable, and legume consumption: Food Insecurity and its associations]. *Segurança Alimentar e Nutricional*, *30*, e023033–e023033. https://doi.org/10.20396/san.v30i00.8673032