1   This is a pre-print version of:

5   **Gender-based eating norms, the family environment and food intake among Costa**
6   **Rican adolescents**

7   **ABSTRACT**

8   **Objective:** To examine the association between family environment variables (parenting

9   styles, family meal atmosphere), gender-based stereotypes, and food intake in Latin

10   American adolescents.

11   **Design:** Structural equation modeling applied to cross-sectional data, 2017.

12   **Setting:** Urban and rural sites of San José, Costa Rica.

13   **Participants:** n = 813; 13-18 years old.

14   **Results:** Data suggest direct associations between gender-based stereotypes and intake of

15   fruits and vegetables (FV) ($\beta = 0.20$, $p < 0.05$), unhealthy foods (fast food, FF) ($\beta = -0.24$, p

16   < 0.01), and ultra-processed foods (UPF) ($\beta = -0.15$, $p < 0.05$) among urban girls; intake of

17   legumes among rural girls ($\beta = 0.16$, $p < 0.05$) and intake of sugar-sweetened beverages

18   (SSB) among rural boys ($\beta = 0.22$, $p < 0.05$). Family meal atmosphere was associated with

19   legume intake ($\beta = 0.19$, $p < .05$) among rural girls. Authoritative parenting style was

20   associated with FV intake ($\beta = 0.23$, $p < 0.05$) among urban boys and FF intake ($\beta = 0.17$, p

21   < 0.05) among urban girls. Authoritarian parenting style was associated with FV

22   consumption ($\beta = 0.19$, $p < 0.05$) among rural boys, and with SSB and FF consumption (β

23   $= 0.21$, $p < 0 .05$; $\beta = 0.14$, $p < 0.05$, respectively) among urban girls.

24   **Conclusions:** Findings are the first to describe the complex family environment and

25   gender-based stereotypes within the context of a Latin American country. They emphasize

26 the need for culturally relevant measurements to characterize the sociocultural context in

27 which parent-adolescent dyads socialize and influence food consumption.

28 **Keywords:** Gender stereotypes, social eating norms, family environment, parenting styles,

29 food intake, Costa Rica, adolescents.

30

31 **INTRODUCTION**

32 Adolescence is a period characterized by psychological, physical, and social

33 transformations that often result in the development of autonomy while an individual is still

34 under the guardianship and norms of a caregiver authority[1,2]. Eating behaviors developed

35 during that stage are shaped by perceived social norms and may persist into adulthood[3,4,5].

36 Conforming to social norms about eating is thought to be a major determinant of dietary

37 quality later in life, affecting the short and long-term consequences of diet-related chronic

38 diseases[6]. Previous studies have reported that gender-based eating stereotypes determine

39 what adolescents choose to eat[7-9-]. For example, femininity stereotypes have been typically

40 associated with consuming vegetables, fruits, fish and sweets, and eating small quantities.

41 In contrast, masculinity has been associated with consuming high energy-dense foods (e.g.,

42 fast food, sugary drinks) and meats (mainly red) and eating quickly and in large

43 quantities[10-15]. Adolescents may be particularly susceptible to gender-based social eating

44 norms that contribute to solidifying their sense of gender identity and peer relations[16-18].

45 As a primary socialization agent, the family environment plays a salient role in

46 defining gender-based norms for children[19-21]. Despite a growing desire for autonomy and

47 independence, adolescent eating behavior is influenced by many aspects of the familial

48 environment. For instance, adolescents whose parents express conservative attitudes toward

49 gender roles are more likely to hold traditional views about what females and males should

50   eat[14-21]. Interactions between parents and children (often called 'parenting styles') have

51   been associated with diet quality in multiple studies[22-27]. Authoritative parenting styles and

52   having meals as a family have been found to protect against unhealthy eating behaviors in

53   adolescents[21-32]. The more parents interact with adolescents during meals, the stronger their

54   influence on weight gain, diet quality, and gender-based eating norms[9, 28-33].

55   Noticeably, most of these studies have been conducted in Anglo-Saxon

56   populations and may not translate to other ethnic groups where the family environment may

57   be influenced by different cultural norms. Societal and cultural norms reinforce traditional

58   dichotomous gender roles for men and women[34] and can modulate socialization practices

59   during interactions between parents and children[34]. In Latin America, parenting styles are

60   generally stricter and less accepting of child autonomy[35,36]. For instance, compared to their

61   North American and European counterparts, Costa Rican adolescents are less likely to

62   contradict their parents[35,37], show greater respect for parental authority, and present higher

63   stress levels in their relationships with their parents[35]. "Familismo," a common Latin

64   American cultural construct, encapsulates the dominant role of the family over the

65   individual[36] and explains why social and cultural constructs, including gender-based

66   stereotypes, may influence eating behaviors and norms.

67   There is anecdotal and qualitative evidence suggesting differences between

68   cultural values and family environments in urban and rural areas, potentially leading to

69   different gender-based stereotypes and eating norms within a particular country[38]. Some

70   studies have reported that peer influence seems to increase with urbanization due to

71   changes generated by the familial work and living arrangements, social expectations, and

72   cultural values[39]. Food availability in urban and rural contexts is very similar; however, as

73   in other parts of the world, there is a higher density of fast-food restaurants in urban areas[40].

74   In our studies of Costa Rican adolescents[41], urban youths (especially males) seem to be

75   more exposed to highly processed foods and beverages. Costa Rican urban adolescents are

76   more likely to buy fast food from international chains or franchises, whereas rural

77   adolescents obtain fast food more frequently at neighborhood convenience stores[42].

78   Nevertheless, the associations between eating behaviors and various aspects of the family

79   environment, such as parenting styles and family meal frequency, have not been studied in

80   Costa Rica and have hardly been noticed in the literature, especially in Latin America.

81   Understanding these associations could possibly inform various promotional strategies for

82   healthful eating among Latin American adolescents and their families.

83   This study sought to elucidate potential associations between family environment

84   variables (parenting styles, family meals), gender-based food intake stereotypes, and

85   dietary intake on a cohort of Costa Rican adolescents. Our objective draws from the

86   socioecological framework positing that individual eating behaviors (consumption of fruits,

87   vegetables, legumes, sugary drinks, ultra-processed foods, and fast food) are influenced by

88   the familial and social environments (gender-based eating norms; rural and urban

89   residence)[16]. We hypothesized that: a) gender-based stereotypes are positively related to

90   nutritious food consumption in girls and unhealthful food consumption in boys, b) family

91   meal atmosphere is related to the consumption of nutritious foods, and c) authoritative

92   parenting styles are associated with consuming nutritious foods, whereas authoritarian

93   parenting styles are associated with unwholesome food consumption. We also wanted to

94   explore how the hypothesized associations varied across areas of residence.

95   **METHODS**

96   **Study Population and Setting:**

97   The study population is drawn from Costa Rican adolescents (ages 13 to 18)

98   enrolled in rural and urban schools in the province of San José. Adolescents represent 18%

99   of the Costa Rican population[43] and are predominantly clustered in San José (30%)[44]. Most

100   are enrolled in the school system (80%), attend school full-time, and do not work for

101   remuneration[44]. Of the adolescents enrolled in public schools, 86% are in urban areas and

102   100% are in rural areas[44]. Public schools offer a school feeding program regulated by the

103   Ministry of Education, which provides free lunches to all students[45]. The school food

104   menus follow national nutritional guidelines and provide 30% of the daily recommended

105   energy intake (2000 Kcal) for adolescents[45].

106   **Data Collection Procedures:**

107   The sample size for the observational study was determined prior to data collection

108   assuming a sampling error for a population proportion with finite population correction[46].

109   Sample selection was carried out in three steps: 1) Schools (n = 16) were selected using a

110   proportional-size probability method[47]. A sampling criterion for schools was whether they

111   were in urban or rural areas of San José. 2) Ten classrooms (two from each grade from 7 to

112   11) were selected in each school using simple random sampling. All the students in the

113   selected classrooms were invited to participate in the study and provided with informed

114   assent forms for themselves and informed consent forms for their parents. 3) Study

115   participants were randomly selected from those who provided signed informed consent and

116   assent forms.

117   Adolescents were first contacted at the schools and invited to participate in the

118   study. Approximately 1500 students received informed assent and consent forms. Both

119   forms had to be duly signed and returned to the investigators before data collection started.

120   Out of 975 (~63%) students that returned the signed assent and consent forms, around 11%

121 decided not to participate in the study before the start. More males than females chose not

122 to participate ($p < 0.05$). There were no differences in age or area of residence between the

123 students who participated and those who did not. The final study sample was 823 students.

124   At each high school, participants were gathered during regular school hours in a

125 classroom reserved for the study. A researcher instructed the students on how to complete a

126 printed survey and was available to answer any questions. Upon completion of the survey,

127 the participants' weight and height were measured. The students were taught how to collect

128 food intake data, as described further below.

129 ***Predictor 1: Gender-based food intake stereotypes:*** Adolescents were asked to fill out the

130 Gender-Based Food Intake Stereotypes Scale (GBFISS), developed and validated for this

131 study[48]. Briefly, this psychometric scale consists of 21 items that measure three dimensions:

132 non-normative subordinate masculinity (stereotypical beliefs on what is considered typical

133 in homosexual or effeminate men, 8 items); normative subordinate femininity (stereotypical

134 beliefs on what is considered ideal in heterosexual girls, 8 items), and normative hegemonic

135 masculinity (stereotypical beliefs on what is considered ideal in heterosexual men, 5 items).

136 Response options follow a 5-point Likert scale ranging from 1 (completely disagree) to 5

137 (completely agree). The scale has a hierarchical structure where gender-based food intake

138 stereotypes are second-order factors; each subscale acts as an indicator. Thus, the three

139 subscales contribute to the measured general construct. The score of each of the dimensions

140 is the average of its items. Reliabilities for each dimension in this sample were: $\alpha = 0.89$ for

141 non-normative subordinate masculinity; $\alpha = 0.84$ for normative subordinate femininity, and

142 $\alpha = 0.70$ for normative hegemonic masculinity. The overall reliability of the scale was $\alpha =$

143 0.87.

144   ***Predictor 2: Family Environment*** was assessed using two constructs: parenting styles and

145   atmosphere during family meals, per previous literature about important diet-related family

146   environment variables[23-32].

147   *Parenting Styles:* Participants filled out a 32-item questionnaire to assess their

148   perception of their parents' parenting styles (Parenting Styles and Dimensions

149   Questionnaire (PSDQ), short version[49]). Responses follow a 5-point Likert scale ranging

150   from never (1) to always (5). Each item on the PSDQ assesses the perception of

151   responsiveness and demandingness of mother and father, separately. In cases where

152   participants lived only with the mother or with a stepfather who did not live with them

153   during childhood, they completed the evaluation for the mother only. Items are loaded into

154   the following subscales: authoritative (high responsiveness and high demandingness),

155   authoritarian (low responsiveness and high demandingness), and permissive (high

156   responsiveness and low demandingness). The score for each of the dimensions is the

157   average of its items. In this sample, the permissive parenting style did not have an

158   acceptable internal consistency for mothers (Cronbach $\alpha = 0.52$) or fathers (Cronbach $\alpha = $

159   0.51); therefore, it was not included in the analysis. The authoritative and authoritarian

160   parenting styles did have acceptable internal consistency for mothers (Cronbach $\alpha = 0.91$

161   and 0.77, respectively) and fathers (Cronbach $\alpha = 0.92$ and 0.77 respectively). Since more

162   than 20% of adolescents did not report parenting style data for fathers (and since focusing

163   on the fathers' styles might require a separate manuscript), this study only includes the

164   mothers' perceived parenting style.

165   *Family Meals* were assessed via the 14-item Family Meals Questionnaire (FMQ[50])

166   to characterize family meal atmosphere (4 items), priority (5 items), and structure/rules (5

167   items). Participants were asked to score each item on a 5-level Likert scale (1 = never, 5 =

168   always). The original instrument was developed for US adolescents (50% Caucasian)[50]. For

169   the current sample, internal reliability was low for priority ($\alpha = 0.61$) and structure/rules (α

170    $= 0.48$). Therefore, only the subscale of family meal atmosphere was considered (Cronbach

171    $\alpha = 0.76$). The score of this subscale is the average of its items. The following questions on

172   family meal atmosphere were included: *How strongly do you agree with the following*

173   *statements? (i) I enjoy eating meals with my family; (ii) In my family, eating brings people*

174   *together in an enjoyable way; (iii) In my family, mealtime is a time for talking with other*

175   *family members; (iv) In my family, dinner time is about more than just getting food, we all*

176   *talk with each other.* The PSDQ and FMQ were translated into Spanish by the authors

177   (native Spanish-speakers from Costa Rica). One hundred adolescents were polled using

178   cognitive interviewing techniques[51] to evaluate survey item comprehension. Survey

179   questions were later revised to increase comprehension.

180   *Age:* Several studies have shown that adolescent dietary quality and participation in

181   family meals decline with increasing age[16,52,54]. Therefore, we considered it relevant to

182   include age as a covariate.

183   ***Main outcomes:*** Diet quality was approximated in the consumption assessment of the

184   following food groups: 1) fruits and vegetables (grams/day), 2) legumes (grams/day), 3)

185   sugar-sweetened beverages (grams/day), 4) ultra-processed food (grams/day), and 5) fast

186   food (grams/day). These food groups were purposely selected because they represent the

187   range of low and high consumption among Costa Rican adolescents, according to our

188   previous analyses showing the differences in various food group intakes across 20 years in

189   Costa Rica[40].

190   Food group outcomes were measured using three-day records[55] completed by the

191   participants in real time and reviewed by nutritionists. To ensure that intake data captured

192   any weekday/weekend variability, half of the participants were randomly selected to record

193   the foods and drinks they consumed on Thursday, Friday, and Saturday, while the rest were

194   asked to record their intake on Sunday, Monday, and Tuesday.

195   At each school, six trained nutritionists provided printed forms to the participants

196   and instructed them on how to complete accurate food records for three consecutive days

197   by having them write down detailed descriptions of everything they ate and drank from the

198   time they woke up in the morning to the time they went to bed at night. Participants had to

199   include food brand names when applicable, and the recipes and methods of preparation of

200   all dishes and drinks whenever possible. The nutritionists taught the participants how to

201   estimate serving sizes using an established manual that was developed for Costa Rica[56].

202   This manual includes photographs and diagrams of 4 to 6 serving sizes and weights for

203   various local foods and preparations. Participants were instructed to report serving sizes

204   using household utensils or volume and mass units.

205   Given the challenges related to incompleteness and inaccuracy when recording self-

206   reported dietary data in young populations and specific demographic groups[57], the

207   nutritionists reviewed the completed 3-day food records thoroughly with each participant

208   during school hours. The nutritionists prompted participants to provide information about

209   commonly missed items or ingredients (e.g., added sweeteners, added fats, candies,

210   beverages); add details about the types of food or drinks consumed (e.g., full fat or

211   skimmed milk, whole or refined flour bread, peeled or unpeeled fruit, drinks with or

212   without added sugar); verify or add serving sizes, and clarify illegible items. The

213   nutritionists used food models, fresh foods, and various utensils to verify serving sizes.

214   Data were collected during nine months of the school year (February to November

215   of 1996, 2006, and 2017), reflecting seasonal variations for Costa Rica: rainy season (May

216   to November) and dry season (December to April).

Data analysis:

218   Using the data from the dietary intake forms, foods were grouped following these

219   criteria: *Fruits and Vegetables* (FV), including all fruits and vegetables, except natural or

220   industrialized juices and raw or fried starchy vegetables; *Legumes*, including all legumes

221   such as beans, chickpeas, and lentils; *Sugar-Sweetened Beverages* (SSB), including all

222   kinds of industrialized sugar-sweetened beverages, carbonated or not, such as industrialized

223   fruit juices and fruit-flavored drinks, carbonated drinks, hydrating drinks, tea-based drinks,

224   water-based natural fruit/mixed fruit and vegetable blended drinks, and *frescos* (a

225   traditional home-made beverage); *Ultra-Processed Foods* (UPF), including

226   salty/sweet/savory extruded or puffed packaged snacks, mass-produced packaged bread,

227   buns, bakery and pastries, and confectionery; *Fast Food* (FF), including local fast foods

228   like empanadas (deep-fried corn dough turnovers filled with meat, potato hash, refried

229   beans, or white farmer's cheese), Costa Rican tacos (deep-fried rolled corn tortillas filled

230   with meat, shredded cabbage and drizzled generously with ketchup and mayonnaise),

231   special croissants (croissant sandwiches filled with meat or cold cuts, processed cheese and

232   fresh tomato), and *'arreglados'* (puff pastries filled with meat, refried beans, and fresh

233   tomato). Other popular fast foods like hot dogs, pizza, hamburgers, wraps, nachos, and fries

234   were also included. Food group intakes were determined on a 1000-Kcal basis to minimize

235   the influence of gender-related differences in energy intake.

236   Structural Equation Modelling (SEM) was used to test five different models, one for

237   each food-group intake variable as the dependent variable. SEM allows filtering out

238   measurement errors and provides information about how well a hypothesized model fits the

239   data. It is a preferred method when assessing psychological constructs, which often include

240   latent variables (consisting of covariances of several items) rather than observed variables

241   (a single score)[58]. Maximum Likelihood was used as an estimation method in the Amos

242   software package (Amos 23.0; SPSS Inc.). To elucidate the influence of family-related

243   variables and gender-based social eating norms on food intake, a model with four predictors

244   (gender-based stereotypes, authoritative and authoritarian parenting styles, and family meal

245   atmosphere), a covariate (age), and one outcome variable was specified (Figure 1). This

246   model was replicated for each of the food intake outcomes, i.e., five models were specified.

247   We also examined whether relationships between putative predictors and each outcome

248   variable differed based on sex and residence area. This was done using unconstrained

249   multi-group SEMs, a variation of SEM that allows examining whether parameters of

250   interest vary appreciably across different samples, i.e., whether sample membership

251   moderates the relations specified in the model[58]. This was accomplished through several

252   multi-group models: five 2-group models, by gender (girls and boys), five 2-group models

253   by area of residence (urban and rural), and five 4-group models by gender and area (urban

254   boys, rural boys, urban girls, and rural girls). All these models added up to twenty SEM-

255   based multiple regression models. All models were adjusted for age.

256   To examine goodness of fit, the following indices were used: Chi-square (χ^2), Chi-

257   square/degrees of freedom ratio (χ^2/df), Tucker Lewis Index (TLI), Comparative Fit Index

258   (CFI), and the Root Mean Square Error of Approximation (RMSEA). As a guideline for

259   evaluating fit, we used established criteria[59,60]. Significant differences between descriptive

260   variables were examined using independent sample t-tests. Missing values were < 5% and

261   were imputed using the Expectation-Maximization algorithm before any analysis was

262   performed.

263   Statistical analyses were performed using the Statistical Package for Social Sciences

264   (SPSS Inc., version 23.0 for Windows, Chicago, Illinois). Only the models that had an

265   acceptable fit are presented in the results section.

266   **RESULTS**

267   Table 1 describes the study sample (n = 813; mean age 15.3 years old; 64%

268   female; 50% living in urban areas). The rural vs. urban subsamples did not differ in terms

269   of gender proportion (36% and 37% were boys in rural and urban areas, respectively; 63%

270   and 64% were girls in rural and urban areas, $p > 0.05$) or age (mean age: 15.1. (1.73) years

271   in rural areas and 14.9 (1.67) years in urban areas, $p > 0.05$). Similarly, gender subsamples

272   did not differ significantly in terms of age.

273   *Food intake differences by sex:* Consumption of legumes, SSB and FF/1000 Kcal

274   was significantly higher ($p < 0.05$) among boys. Rural adolescents consumed significantly

275   more ($p < 0.001$) legumes/1000 Kcal than urban adolescents. Considering psychosocial

276   variables, boys reported higher levels of gender-based food intake stereotypes (2.71 units of

277   score, $p < 0.01$) and authoritarian parenting style ($p < 0.05$) when compared to girls.

278   *Food intake differences by area of residence:* Urban adolescents consumed

279   significantly more SSB ($p < 0.001$) and FF ($p < 0.01$) per 1000 Kcal than their rural

280   counterparts. There was also a marginally higher consumption of fast foods in urban areas

281   ($p = 0.06$) and of FV ($p < 0.001$) and legumes ($p < 0.001$) in rural areas.

282   *Family Environment differences by area of residence*: Considering differences in

283   psychosocial variables by residence area, rural participants reported higher levels of

284   authoritative parenting ($p < 0.01$) while urban participants reported higher levels of

285 authoritarian parenting ($p < 0.001$). No differences were found in the mean score for family

286 meal environment between boys and girls or urban and rural adolescents.

287 **Influences of family environment variables and gender-based social eating norms on**

288 **food-group intake.** Results from the SEM models, adjusted by age, are reported in Tables

289 2 (model fit indices) and 3 (direct associations between variables). Absolute fits were

290 acceptable for the presented models, both in the general sample and in the subgroups based

291 on sex or residence area (Table 2) using established criteria as reference [59,60]. The

292 incremental fit (CFI, TLI) of the multi-group models was somewhat lower, suggesting that

293 some putative predictors were not associated with food intake. All correlations among

294 factors in the measurement models ranged from -0.31 to 0.52, suggesting that there are no

295 reasons to suspect overlap between variables and the models have met the assumption of no

296 collinearity required for this analytic strategy.

297   Table 3 details the model results for the associations (measured by regression β

298 weights) between family environment, gender-based social eating norms, and food intake

299 outcome variables, in the general 1-sample model, and in the 2-sample multi-group models.

300   *Gender-based food intake stereotypes* were associated with the intake of nutritious

301 food items among girls (FV, $\beta = 0.12$, $p = 0.05$; legumes, $\beta = 0.16$, $p < 0.01$) and with lower

302 consumption of FF ($\beta = -0.19$, $p < 0.001$). Interestingly, SSB intake was associated with

303 stereotypes only among boys ($\beta = 0.22$, $p < 0.05$) and urban adolescents ($\beta = 0.14$, $p <$

304 0.05).

305   Further analyses based on a 4-sample multi-group model to examine the potential

306 moderating joint effect of both gender and area of residence suggest that gender-based

307 stereotypes and food intake associations vary by a combination of these variables (Table 4).

308   For example, the positive association between stereotypes and FV intake evidenced in girls

309   was found only among urban girls ($\beta = 0.20$, $p < 0.05$), while the association with legume

310   intake was evidenced only in rural girls ($\beta = 0.16$, $p < 0.05$). Likewise, the inverse

311   association between stereotypes and unhealthy food items (FF and UPF) was evidenced in

312   urban girls only ($\beta = -0.24$, $p < 0.01$; $\beta = -0.15$, $p < 0.05$, respectively). Among boys, the

313   association between gender-based stereotypes and SSB intake was found to be specific to

314   the rural area ($\beta = 0.22$, $p < 0.05$).

315   *Family meal atmosphere* was associated with legume intake only among girls ($\beta =$

316   0.17, $p < 0.01$) and rural adolescents ($\beta = 0.21$, $p < 0.05$). In the multi-group SEM, the

317   positive association between atmosphere and legume intake is only evident among rural

318   girls ($\beta = 0.19$, $p < .05$).

319   *Parenting Styles:* An authoritative parenting style was significantly related to FV

320   intake among boys ($\beta = 0.18$, $p < 0.05$), and to FF and SSB intake among urban adolescents

321   ($\beta = 0.12$, $p = 0.05$; ($\beta = 0.13$, $p = 0.05$, respectively). Interestingly, in rural areas, the

322   authoritarian, not the authoritative, parenting style was the one associated with higher

323   consumption of FV ($\beta = 0.13$, $p < 0.05$). Additionally, the authoritarian style was

324   associated with SSB intake among girls ($\beta = 0.11$, $p < 0.05$).

325   Results from the multi-group analysis suggest that the positive association between

326   the authoritative style and FV intake in boys is specific to those living in urban areas ($\beta =$

327   0.23, $p < 0.05$). Further, the authoritative style was associated with FF intake only among

328   urban girls ($\beta = 0.17$, $p < 0.05$). In contrast, the marginal association between the

329   authoritative style and SSB intake among urban adolescents was not statistically

330   significant. Multi-group analysis also suggests a positive association between the

331   authoritarian parenting style and FV consumption only among rural boys ($\beta = 0.19$, $p <$

332   0.05), and a positive association between this style and SSB and FF consumption only

333   among urban girls ($\beta = 0.21$, $p < 0.05$ and $\beta = 0.14$, $p < 0.05$ respectively).

334   **DISCUSSION**

335   This study sought to expound on potential associations between family environment

336   variables (parenting styles, family meal atmosphere), gender-based food intake stereotypes,

337   and dietary intake in a cohort of Latin American rural and urban adolescents. The results

338   suggest direct associations between the above criteria and intake of specific food groups

339   and that these associations may act differently on specific subgroups (rural vs. urban boys

340   and girls). Specifically, the results suggest an association between gender stereotypes and

341   intake of nutritious food items (e.g., more FV and legumes, less FF and UPF) among girls

342   and between gender stereotypes and consumption of unhealthy foods (SSB) among boys.

343   This is in agreement with previous literature (mostly qualitative studies[10-15]) suggesting that

344   food wholesomeness can be regarded as 'masculine' or 'feminine,' and that, in consuming

345   foods in agreement with gender stereotypes, adolescents may be consolidating the

346   construction of their own gender identity[38]. The associations were more pronounced or

347   apparent depending on area of residence, with more FV and less unhealthy food intake

348   among urban girls, and with legume intake among rural girls. Likewise, the association was

349   more pronounced among rural boys with more SSB consumption. This last result seems

350   contrary to those from the 2-sample multi-group models. Specifically, the 2-sample

351   analyses showed an association between gender norms and SBB intake in urban

352   adolescents, but the 4-sample multi-group analysis found the effect only in rural boys. This

353   might be related to sample sizes and effects on specific subgroups. When the sample is split

354   into urban boys and girls, some statistical power is lost, and the effect is no longer found.

355   When the sample is split into urban and rural boys, the effect is present only in rural

356   inhabitants.

357   According to our findings, family meal atmosphere was directly associated with

358   various food intake outcomes, but in different subpopulation groups. For example, family

359   meal atmosphere was directly associated with legume intake only among girls and rural

360   adolescents; the multi-group model suggests that the association was only significant

361   among rural girls. Barring the obvious social desirability response bias[61], other

362   investigators have suggested that the psychological association between nutritious food

363   intake and family meals may be more prominent in girls than boys[62, 63], plausibly because

364   parents have a stronger or more direct influence on the socialization processes of girls[62].

365   This may be even more pronounced in the context of a Latin American traditional culture

366   that reinforces monolithic, hierarchical gender roles, especially in rural areas[34]: men are

367   portrayed as dominant, independent figures in society, and women as obedient figures

368   whose role is to complement and support the leadership of men in their families and

369   society[34]. In these circumstances, rural boys could be more likely to adopt socially

370   established 'masculine' norms and gender-based food intake stereotypes.

371   The findings on parenting styles and their association with gender and food intake

372   in various subgroups are more difficult to interpret. While in urban areas the authoritative

373   parenting style was associated with higher FV intake among boys (keeping in agreement

374   with previous literature in other study populations[64,65], it was also associated with higher FF

375   intake among girls. In contrast, the authoritarian parenting style was associated with higher

376   SSB and FF intake among rural girls (also in agreement with previous literature[66], but also

377   with FV consumption among rural boys. These findings add to previous conclusions that

378   the influence of parenting styles varies by food type and by the sociocultural context in

379   which the parent-child dyads socialize[67].

380   Most published literature on adolescents and eating habits focuses on urban youth.

381   There is no literature on parenting styles and food consumption among rural adolescents,

382   making any comparisons to our results complicated. Parenting styles may change according

383   to the level of urbanization and the norms, attitudes, beliefs, and values assigned to the

384   various family structures and emotional climate within which parents and adolescents

385   interact[68]. Our findings assert the need for future research to throw light on those

386   associations and on the interrelationships between parents and adolescents. A deeper

387   understanding of these intersectionalities will help inform public health promotion

388   strategies for healthy eating among Costa Rican adolescents.

389   The cross-cultural application of the traditional parenting styles questionnaire[69,70] to

390   diverse populations can be disputed. Some researchers question the universal suitability of

391   parenting styles developed and validated largely for white, middle-class Americans,

392   asserting that it has limited transferability to other populations, and suggesting that it does

393   not capture Latin American culture and parental belief systems[71-74]. Parenting behaviors

394   may be reactive to children's characteristics and the cultural and socioeconomic contexts in

395   which families live. Among children from diverse ethnic backgrounds, cultural differences

396   may alter children's interpretations and responses to their parent's parenting styles[70,71,75-78].

397   Some studies[71-74] have found Latino parents to employ more authoritarian parenting styles,

398   which has been associated with negative outcomes in other population groups. A more

399   recent study has shown some variability in terms of child outcomes dependent on ethnicity

400   (e.g., Mexican American and Dominican American)[79]. Culturally relevant and appropriate

401   instruments should be used to assess parenting styles and family meal environments

402   because they have serious implications on the design of family interventions. The

403   evaluation of parenting styles must be refined to a measurement that is time-, person- and

404   context-specific. Researchers should devote time to adapt and develop culturally sensitive

405   measures of the constructs they employ to understand the complex relationship between

406   cultural and psychosocial variables and dietary intake, as others have suggested[71,72,74].

407   Our findings contribute with quantitative data and analysis to the corpus of social

408   anthropology literature about the numerous social meanings of food and food-related

409   practices, beyond the mechanical act of feeding itself[80].

410   **STRENGTHS AND LIMITATIONS**

411   This study has several strengths and limitations. First, the cross-sectional

412   associations must be interpreted as descriptive, and do not suggest causality or direction. As

413   the analyses were adjusted by eliminating the possible bias produced by age, results show a

414   situation that is closer to reality. However, the social environment of Costa Rican urban and

415   rural adolescents warrants further careful studies in order to design an integrated strategy

416   for the promotion of healthy eating in this population group.

417   Secondly, in the study sample, the only subscales with an acceptable Cronbach's

418   Alpha (close to 0.80) were the authoritative and authoritarian parenting styles subscales of

419   the Parenting Styles and Dimensions Questionnaire, and the family meal atmosphere

420   subscale of the Family Meals Questionnaire. This raises questions about the psychometric

421   properties of these tests when used to describe parental practices within the Latin American

422   family environment, as others have suggested[71,72]. As discussed earlier, using a parenting

423   styles questionnaire that is not sufficiently sensitive to Latin American styles has potential

424   implications. Likewise, the instrument used to study family meals (developed for Project

425   EAT) may not adequately measure family dynamics around meals in a Latin American

426   context. This practice is influenced by family structure, rules at family meals, and social

427   background, as has been evidenced for Chilean families[81]. Still, the PSQD and FMQ were

428   cognitively evaluated to ensure that the questions were easily understood and accurately

429   reported by the adolescents.

430   In contrast, the scale designed to measure gender stereotypes has good reliability

431   and is culturally sensitive for this population. Opportunities for future research are worth

432   mentioning. For instance, although the gender-based stereotype scale was validated through

433   its correlations with sexism[48], one might consider a cultural overlap between gender and

434   sexual orientation conceptions, as has been evidenced in other social contexts[82,83]. Further

435   research on how gender stereotypes influence a sample of sexually diverse adolescents

436   might provide valuable insights into our understanding of cultural influences on food

437   intake.

438   Finally, our results provide some insight into how the associations between

439   variables vary based on gender and area of residence. A future study could include more

440   detailed analyses on the scales' psychometric properties and invariance levels[58] to gain a

441   better understanding of any potential differences in the scales' interpretation by gender and

442   area of residence, and how these differences may affect the reported patterns of

443   associations.

444   **CONCLUSION**

445   These findings attempt to describe associations between gender-based norms, the

446   complex family environment, and dietary intake in urban and rural adolescents. They

447   emphasize the need for further research on the familial, sociocultural, psychological, and

448   economic contexts in which parenting practices and styles occur in order to help inform

449   public health promotion strategies for healthy eating among Latin American adolescents.

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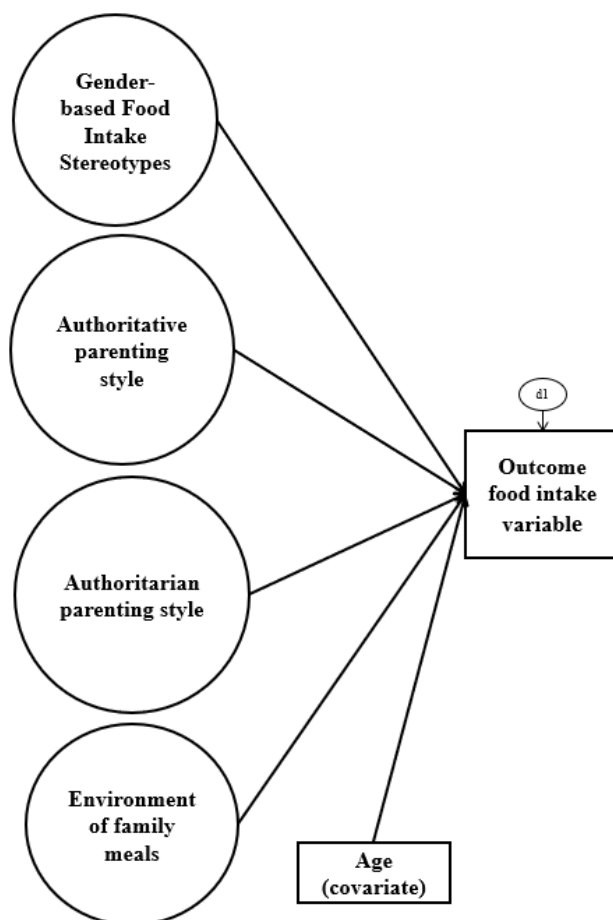
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FIGURES

Figure 1. Basic Structural Equation Model specified in this study. Only structural loadings are depicted. This model was separately specified and estimated five times, one for each of the food intake outcome variables: fruits and vegetables, legumes, sugary drinks, ultra-processed foods, and fast food. Models were adjusted by age. Information on results for these models is presented in tables 2, 3, and 4.

Table 1. Description of study sample for the general study population and by sex and area of residence per study variable

| Variables[1] | General n = 813 | | Sex[2] | | | | Area[2] | | | |
| | | | Girls n = 519 | | Boys n = 294 | | Urban n = 408 | | Rural n = 405 | |
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fruits and vegetables intake (g/d/1000 Kcal)	36.7	27.3	34.5	36.5	31.1	27.3	32.1	23.4	27.6	24.4
Legumes intake (g/d/1000 Kcal)	22.1	24.1	19.5	16.5	26.7***	20.6	16.6	27.3	41.4***	36.3
Sugary drinks intake (g/d/1000 Kcal)	155.8	136.6	149.7	132.8	166.5**	142.6	188.4***	148.7	128.9	117.4
Ultra-processed foods intake (g/d/1000 Kcal)	10.4	6.0	9.9	5.9	10.7	6.2	10.6	6.3	10.2	4.8
Fast food intake (g/d/1000 Kcal)	19.3	15.9	21.4	28.7	36.7*	18.2	22.3**	12.9	16.4	11.3
Gender-based food intake stereotypes	2.1	0.5	2.0	0.5	2.2	0.6**	2.1	0.5	2.2	0.6
Family meal environment	3.2	0,7	3.2	0.7	3.2	0.7	3.2	0.7	3.1	0.7
Authoritative parenting style	3.4	1.1	3.4	1.1	3.5	1,1	3.5	1.1	3.3	1.1
Authoritarian parenting style	1.8	0.9	1.7	0.9	1.9*	0.9	1.7	0.8	1.9	0.9

[1] Values are means ± SD. [2] Mean differences were determined using independent sample t-tests. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Note: For every variable, kurtosis and skewness were within the levels suggested by Kline (2011).

Table 2. Model fit indices per food intake variable in the general and group models by sex and by residence area

Outcome variable	Fit indices
A) Measurement and general models	
Fruits and vegetables	χ^2 (649) = 1385.726, χ^2/df = 2.13, CFI = 0.93, TLI = 0.92, RMSEA = 0.037 [0.035-0.040])
Legumes	χ^2 (649) = 1398.306, χ^2/df = 2.15, CFI = 0.93, TLI = 0.92, RMSEA = 0.038 [0.035-0.040])
Sugary drinks	χ^2 (649) = 1389.703, χ^2/df = 2.14, CFI = 0.93, TLI = 0.92, RMSEA = 0.037 [0.035-0.040])
Ultra-processed foods	χ^2 (649) = 1376.657, χ^2/df = 2.12, CFI = 0.93, TLI = 0.92, RMSEA = 0.037 [0.034-0.040])
Fast food	χ^2 (649) = 1379.111, χ^2/df = 2.12, CFI = 0.93, TLI = 0.92, RMSEA = 0.037 [0.034-0.040])
B) Multiple group models by sex	
Fruits and vegetables	χ^2 (1298) = 2225.775, χ^2/df = 1.71, CFI = 0.91, TLI = 0.91, RMSEA = 0.030 [0.028-0.032])
Legumes	χ^2 (1298) = 2250.226, χ^2/df = 1.73, CFI = 0.91, TLI = 0.90, RMSEA = 0.030 [0.028-0.032])
Sugary drinks	χ^2 (1298) = 2224.730, χ^2/df = 1.71, CFI = 0.91, TLI = 0.91, RMSEA = 0.030 [0.028-0.032])
Ultra-processed foods	χ^2 (1298) = 2207.951, χ^2/df = 1.70, CFI = 0.91, TLI = 0.91, RMSEA = 0.029 [0.027-0.031])
Fast food	χ^2 (1298) = 2219.925, χ^2/df = 1.71, CFI = 0.91, TLI = 0.91, RMSEA = 0.030 [0.027-0.032])
C) Multiple group models by residence area	
Fruits and vegetables	χ^2 (1298) = 2345.132, χ^2/df = 1.80, CFI = 0.90, TLI = 0.90, RMSEA = 0.032 [0.029-0.034])
Legumes	χ^2 (1298) = 2398.197, χ^2/df = 1.79, CFI = 0.90, TLI = 0.90, RMSEA = 0.031 [0.029-0.033])
Sugary drinks	χ^2 (1298) = 2330.090, χ^2/df = 1.79, CFI = 0.90, TLI = 0.90, RMSEA = 0.031 [0.029-0.033])
Ultra-processed foods	χ^2 (1298) = 2324.523, χ^2/df = 1.79, CFI = 0.90, TLI = 0.90, RMSEA = 0.031 [0.029-0.033])
Fast food	χ^2 (1298) = 2321.081, χ^2/df = 1.79, CFI = 0.90, TLI = 0.90, RMSEA = 0.031 [0.029-0.033])

Table 3. Direct age-adjusted associations between psychosocial inputs and food group intake outcome variables by sex and area of residence[1,2]

Outcome variable	General sample n = 813	Girls subsample n = 519	Boys subsample n = 294	Rural subsample n = 405	Urban subsample n = 408
Predictor: Gender-based stereotypes					
Fruits and vegetables (g/d)	0.03	0.12*	-0.07	-0.04	0.06
Legumes (g/d)	0.10*	0.16**	-0.01	0.06	0.10
Sugary drinks (g/d)	0.11*	0.03	0.22*	0.08	0.14*
Ultra-processed foods (g/d)	-0.04	-0.06	-0.01	-0.01	-0.04
Fast food (g/d)	-0.09*	-0.19**	0.03	-0.08	-0.09
Predictor: Family meals					
Fruits and vegetables (g/d)	0.02	-0.01	0.06	0.05	0.01
Legumes (g/d)	0.12*	0.17**	0.06	0.21**	0.05
Sugary drinks (g/d)	-0.03	-0.01	-0.06	-0.05	-0.03
Ultra-processed foods (g/d)	0.02	0.02	0.01	0.06	-0.03
Fast food (g/d)	-0.04	-0.10	0.03	0.01	-0.08
Predictor: Parenting styles (authoritative, authoritarian coefficients)					
Fruits and vegetables (g/d)	0.11*, 0.03	0.07, -0.01	0.18*, 0.09	0.06, 0.13*	0.11, 0.00
Legumes (g/d)	-0.00, -0.05	-0.00, -0.05	-0.06, -0.11	0.00, 0.05	-0.06, -0.09
Sugary drinks (g/d)	0.06, 0.05	0.06, 0.11*	0.05, -0.04	0.13†, -0.03	0.04, 0.08
Ultra-processed foods (g/d)	0.07, 0.01	0.08, 0.04	0.04, -0.04	0.07, -0.07	0.08, 0.09
Fast food (g/d)	0.04, 0.00	0.07, 0.05	-0.01, -0.07	-0.04, -0.06	0.12†, 0.05

[1] Data derived from SEM analysis. [2] Relationships between psychosocial inputs and food intake outcome variables are expressed in terms of standardized regression coefficients (β). g/d: grams/day, * $p < 0.05$, ** $p < 0.01$, † $p = 0.05$.

Table 4. Age-adjusted associations between psychosocial inputs and food group intake outcome variables by sex and area of residence[1,2]

Outcome variable	Boys		Girls	
	Rural n = 146	Urban n = 151	Rural n = 258	Urban n = 258
Predictor: Gender-based stereotypes				
Fruits and vegetables (g/d)	0.07	-0.10	-0.01	0.20*
Legumes (g/d)	-0.12	0.08	0.16*	0.09
Sugary drinks (g/d)	0.22*	0.12	-0.00	0.10
Ultra-processed foods (g/d)	-0.18	0.17	0.06	-0.15*
Fast food (g/d)	-0.09	0.20	-0.09	-0.24**
Predictor: Family meals				
Fruits and vegetables (g/d)	0.09	0.06	0.03	0.00
Legumes (g/d)	0.20	-0.07	0.19*	0.13
Sugary drinks (g/d)	-0.06	-0.03	-0.03	0.00
Ultra-processed foods (g/d)	-0.01	-0.04	0.11	-0.06
Fast food (g/d)	0.04	-0.05	-0.02	-0.13
Predictor: Parenting styles (authoritative, authoritarian coefficients)				
Fruits and vegetables (g/d)	0.07, 0.19*	0.23*, 0.02	0.06, 0.11	0.04, -0.04
Legumes (g/d)	-0.09, 0.02	0.00, -0.17	0.08, 0.04	-0.14, -0.05
Sugary drinks (g/d)	0.20, 0.02	-0.09, -0.11	0.08, -0.06	0.08, 0.21**
Ultra-processed foods (g/d)	0.13, -0.04	0.05, 0.01	0.04, -0.10	0.11, 0.14†
Fast food (g/d)	-0.00, -0.00	0.05, -0.09	-0.07, -0.11	0.17*, 0.14*
Model fit indices per food intake variable in each multigroup model				
Outcome variable	**Fit indices**			
Fruits and vegetables (g/d)	$\chi^2(2724) = 4468.705$, χ^2/df = 1.64, CFI = 0.85, TLI = 0.84, RMSEA = 0.028 [0.027-0.030])			
Legumes (g/d)	$\chi^2(2724) = 4458.164$, χ^2/df = 1.63, CFI = 0.85, TLI = 0.84, RMSEA = 0.028 [0.027-0.030])			
Sugary drinks (g/d)	$\chi^2(2724) = 4439.041$, χ^2/df = 1.63, CFI = 0.85, TLI = 0.84, RMSEA = 0.028 [0.026-0.029])			
Ultra-processed foods (g/d)	$\chi^2(2724) = 4423.349$, χ^2/df = 1.62, CFI = 0.85, TLI = 0.85, RMSEA = 0.028 [0.026-0.029])			
Fast food (g/d)	$\chi^2(2724) = 4423.349$, χ^2/df = 1.62, CFI = 0.85, TLI = 0.85, RMSEA = 0.028 [0.026-0.029])			

[1] Data derived from multigroup SEM analysis, [2] Relationships between psychosocial inputs and food intake outcome variables are expressed in terms of standardized regression coefficients (β). g/d: grams/day, * $p < 0.05$, ** $p < 0.01$, † $p = 0.05$.