Snack consumption is decreasing in Colombia among the youngest, the most educated, and the wealthiest: results of two representative national surveys.

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Abstract

Background: A common recommendation is to reduce the consumption of snack food and replace this consumption with nutrient-dense foods. The objective was to establish whether there were changes in adherence to the consumption of the snack pattern (SP) in Colombian children and adults in the 2010-2015 quinquennium. In addition, this study aimed to establish the relationship between the SP and some biological, socioeconomic, and geographic variables in Colombia, Sur América.

Methods: Based on a Food Frequency Questionnaire (FFQ) applied both in 2010 and 2015 in the national nutritional situation surveys, the adherence to the snack consumption pattern was established through factor analysis. The change in the adherence of consumption to the SP was established for the five-year period [2015 minus 2010], using multiple linear regression models. Crude and adjusted differences were estimated by the following covariables: sex, age, marital status, food security, wealth index, ethnicity, education of the head of the household, area and region. In total, 37,981 subjects were analyzed. In 2010, 10,150 children (5 to 17 years old) and 5,145 adults (18 to 64 years old) were included, and in 2015, 13,243 children and 9,443 adults.

Results: In children, the adjusted difference in the adherence to SP was -0.37 (95% CI: -0.42, -0.32), p < 0.0001. In adults, the adjusted difference in the adherence to SP was -0.27 (95% CI: -0.31, -0.24), p < 0.0001. In all categories of covariables, consumption decreased, for all p < 0.0001. In children the decrease in consumption was inversely associated with body mass index (BMI) and height and was directly associated with the level of food security in the home and the wealth index. In adults the decrease in consumption was inversely related to age and BMI and directly related to the size, the level of food security of the household, wealth index, and education level.

Conclusions: In the quinquennium there is a decrease in the adherence to the SP, the
region, the wealthiest, the tallest, the best BMI and the most educated displayed the
greatest decrease in the SP. Keywords Food Pattern; Snack Pattern; Intake of Snack;
Children; Adults; Colombia.

Background

Nutritional epidemiology has studied the relationship between diet and disease from the
perspective of nutrients, food, and eating patterns [1–9]. Autochthonous diets recognized
for their cardioprotective effects, such as the Mediterranean [10,11] or Eskimo or Inuit
[12] diets, are the expression of what we now understand as traditional or ancestral food
patterns. Evidence suggests that adhering to traditional dietary patterns - regardless of
the geographical context - protects or delays the undesirable effects of ultraprocessed
foods and other patterns in health, such as the so-called “western” diet, which consists of
a high content of refined foods, sugar, saturated fat, ultraprocessed ingredients and, in
general, items considered snack foods [13–16].

In countries with high and medium incomes, snack consumption contributes to between
20–40% of the total energy/day [17–19]. Snack consumption in children and adults has
been associated with the development of adiposity, annual changes in body mass index
(BMI), and subcutaneous fat (SCF) [20–22]; it is also positively associated with waist
circumference and SCF thickness in overweight and obese men and women [23,24].
Contradictory evidence to these associations is apparently the result of reverse causality
and the different ways in which snack consumption is defined and measured [21,25,26].

Despite the obvious limitations in defining and measuring snack consumption [25], a
common recommendation is to reduce the consumption of snack food and replace this
consumption with nutrient-dense foods. Because of a set of actions on the environment
and individuals that have been systematically performed during the last 30 years in the
United States, the period of 2003–2010 showed a substantial decrease in the consumption
of calories derived from sugar sweetened beverages (SSB) and snacks [27].

The objective of this study was to establish whether there were changes in adherence to the consumption of the snack pattern (SP) in Colombian children and adults in the 2010–2015 quinquennium. In addition, this study aimed to establish the relationship between the SP and some biological, socioeconomic, and geographic variables.

Methods

Population studied

During the last 8 years in Colombia, the Colombian Family Welfare Institute (Instituto Colombiano de Bienestar Familiar, ICBF) has performed two national surveys of the nutritional situation (ENSIN, 2010 and 2015) [28,29]. The details of these ENSINs have already been published. In summary, the ENSINs are designed to represent 99% of the population through stratified multistage sampling. All 33 geodemographic units are grouped based on similar geographic and sociodemographic characteristics. The municipalities in these units are randomly selected and compose strata with a probability proportional to the size of the population. Clusters of approximately 10 households are randomly selected within these strata, and members of households are invited to participate. In 2010, the survey included 50,670 households, representing 4,987 clusters of 258 strata. In 2015, the survey included 44,202 households, representing 4,739 clusters of 177 strata. Consent to participate was obtained by the ICBF before the recruitment of the households and subjects.

Data sources

In both surveys, trained personnel administered questionnaires to the head of the household to obtain sociodemographic information on food security and the level of household wealth. In addition, nutritionists applied in a randomly selected sub-sample a Food Frequency Questionnaire (FFQ). Children under 12 years of age were assisted by
their caregivers to respond to the FFQ. The checklist of food and food groups was designed by nutritionists based on the nutrition problems identified in the ENSIN-2005. The response section was adapted from two reproducibility and validity studies of FFQs used in the Colombian population [30,31]. The facial validity of all the items on the checklist was guaranteed. The anthropometric measurements were also taken by trained nutritionists using standardized techniques and calibrated equipment. Height was obtained with stadiometers (Shorr Productions LCC, Olney, MD, USA) and was measured to the nearest millimeter. Weight was obtained with SECA scales (model 872 in 2010 and model 874 in 2015) and was measured to the nearest 100 g.

In 2010, the FFQ was applied to 7,138 subjects between 18 and 64 years old; in 2015, it was applied to 11,530 subjects. Of these subjects, we excluded pregnant women (in 2010, \( n = 1679 \); in 2015, \( n = 1134 \)), those who practiced prescribed diets (in 2010, \( n = 255 \); in 2015, \( n = 304 \)), and subjects measuring less than 100 cm or more than 200 cm or weighing less than 40 kg or more than 200 kg. In addition, in 2010, the FFQ was applied to 10,756 subjects between 5 and 17 years old, and in 2015, it was applied to 10,092 subjects. Of these, we excluded pregnant girls (in 2010, \( n = 257 \); in 2015, \( n = 159 \)), those who practiced prescribed diets (in 2010, \( n = 128 \); in 2015, \( n = 126 \)), and subjects measuring less than 80 cm or more than 200 cm or weighing less than 12 kg or more than 200 kg. In total, 37,981 records were analyzed. In 2010, 10,150 children (5 to 17 years old) and 5,145 adults (18 to 64 years old) were included, and in 2015, 13,243 children and 9,443 adults were included.

In 2010, the 10 responses in the FFQ regarding the frequency of consumption of 28 food items were converted to a continuous variable: “times/day”. This variable was assessed using a factor analysis, and three consumption patterns were established. The three established patterns were the SP [package foods, sweets, soft drinks (powder, box,
bottle), fast food, butter, sausages, chicken starters], fruit-vegetable/dairy [milk, cheese, kumis, yogurt, cream cheese ..., raw vegetables, cooked vegetables, whole fruits, fruits in juice, bread, arepa or cookies, whole-grain, chicken, black pudding or beef viscera, low calorie foods (light), tuna or sardines], and traditional/starch [panela, sugar, honey, rice or pasta, fried foods, dry beans, tubers or banana, eggs, beef, veal, pork ..., fish or seafood, coffee or tea]. In 2015, similar to 2010, the responses of the frequency of consumption in the FFQ became a continuous variable measured in “times/day”, and the same 28 foods of the FFQ were analyzed factorially to keep the results between the surveys comparable. The standardized scores obtained based on the frequency of consumption and the factorial loads were declared as the adherence that each subject had to each of the three established patterns.

The variable of interest was adherence in consumption to the SP - point Z. The primary exposure was the year of conducting the survey (2010 or 2015). In addition, for each survey, other covariables were considered in relation to adherence to the SP, including sex, age, height, BMI (in children, the equivalent value was obtained according to International Obesity Task Force) [32], marital status, state of food security in the home, wealth index, ethnicity, education of the head of the household, the level of urbanism, and the geographical region where the subjects live. The level of urbanism was categorized as those who live in urban areas of large cities and those who live in rural areas. The rural category included suburban population centers close to small cities, principal rural areas distant from small cities and dispersed or very distant populations of rural principal settlements. The food security status of the home was established using the Latin American and Caribbean Scale of Food Security (ELCSA), a modified version of the Community Childhood Hunger Identification Project, which has undergone successive adaptation and validation processes in Colombia [33]. Wealth was established using the
index designed for the international population and health survey [34]. This index was constructed in the same way for the two surveys through an analysis of the main components with household information, which included, among others, the type of construction material of the dwelling, the characteristic of the sanitary services, and in general, the goods and services that the household has. The first component was used to create the index as a variable of continuous type (Z score), which is assigned to each subject within the household. The highest values represent the wealthiest subjects. The wealth index was categorized by incorporating the complex design of the sample into quintiles according to the distribution reached among all the participants in each survey.

**Statistical analysis**

All analyses were conducted using the analysis routines for complex sample designs of Stata software, version 14.1 [35]. An analysis was conducted to estimate the average adherence to SP in the covariable categories. In addition, using a multiple linear regression with adherence to SP as the dependent variable, we estimated the adjusted differences for each of the categories in all covariates and their 95% confidence intervals (95% CIs). To obtain the adjusted differences, a new term was created as the cross product between the year and each category of the covariates (interaction). The adjusted differences incorporated the complex design of the sample, and the multiple regression model included the following covariates: sex, age, marital status, food security, wealth index, ethnicity, education of the head of household, area, and region. Finally, using a multiple linear regression, crude and adjusted differences and their respective 95% CIs were estimated between the frequency/day of consumption for the main items that compose the SP.

**Institutional review board**

The authors declare that all procedures that contributed to this work comply with the
ethical standards of the Declaration of Helsinki, revised in 2008. The research ethics committee of the National Institute of Health of Colombia approved the survey protocol, and all participants provided informed consent. The health research ethics committee of the Universidad Industrial de Santander states that anonymized data analyses are exempt from review.

Results

In children

In 2010, 49.3% of the subjects were girls. The mean age ± SE of the subjects was 11.8 ± 0.05 years, which differed by sex (p = 0.041). In 2015, 49.0% of the subjects were girls. The average age of the subjects was 11.0 ± 0.07 years, which differed by sex, with girls being an average of three months older (p = 0.001).

The adjusted difference in adherence to the SP was −0.37 (95% CI: −0.42, −0.32, p < 0.0001). In each year, age, height/age, and wealth index were directly associated with consumption. Those who live in urban areas consumed more. In all categories of variables, consumption decreased (p < 0.0001 for all). In this period, the decrease was greater in girls and in those who live in urban areas. The decrease in consumption was inversely associated with BMI and height and was directly associated with the level of food security in the home and the wealth index (Table 1).

In adults

In 2010, 55.2% of the subjects were women. The mean age ± SE of the subjects was 37.5 ± 0.24 years, which did not differ by sex. In 2015, 55.1% of the subjects were women. The mean age of the subjects was 37.8 ± 0.23 years, which differed by sex, with women being an average of two years older (p < 0.0001).

The adjusted difference in adherence to SP was −0.27 (95% CI: −0.31, −0.24, p < 0.0001). In each year, age and BMI were inversely associated with consumption and were directly
associated with height and wealth index. Men, married people, and those who live in urban areas consumed more. In all categories of variables, consumption decreased (p < 0.0001 for all). In the period, the decrease was greater in men, single people, and those who live in urban areas. The decrease in consumption was inversely related to age and BMI and directly related to the size, the level of food security of the household, wealth index, and education level (Table 2). Figure 1 illustrates the reduction in the pattern of snack consumption.

Food determinants in the food transition.

Table 1S [Supplementary Material online] shows the weight of each food in the SP based on the factorial loads. Table 2S [Supplementary Material online] shows the differences in the five-year period in the frequency/day of food consumption. In the SP, the most influential foods that decreased in consumption in children were candy, sweets, and packaged foods. The most influential foods that decreased in consumption in adults were candy, sweets, soda, SSB, and packaged foods.

Discussion

In the quinquennium studied consumption in the SP decreased by 13.3% (p < 0.0001). The decrease was directly associated with the wealth index and education level of the head of the household. The decrease in SP consumption reflects that an adjustment in the food consumed, in favor of a better diet, is being made by the richest and most educated subjects in society.

The decrease in the SP was consistent in all the variables studied and geographical regions. However, according to the World Health Organization (WHO) for the period of 2000–2013 in Colombia, sales of ultra-processed foods had a sustained growth of 1.9%
This increasing trend was shown in 12 countries in the Americas region, except in Argentina, where the decrease in snack consumption is explained by the economic crisis suffered by that country. In this same period (2000–2013), snack sales grew by 6.1% in Asia and the Asian Pacific, 3.1% in Latin America, and 0.2% in the US. According to the WHO, Colombia comprises 16.8% of the global snack market [36]. The previous figures for Colombia do not include the possible effect of messages and media campaigns against snack, sugar, soft drink and SSB consumption that increased and remained visible for the entire population during 2014–2017, which was a result of a failed attempt by the Ministry of Health to taxes the consumption of soft drinks and SSB [37]. The results presented here are not contradictory with those reported by the WHO because difficulty in comparison was previously noted when defining what a snack is and how to measure their consumption [25].

In both ENSINs, the decrease in snack consumption was greater in men. The consumption of snacks does not differ by sex, but in adults, snack consumption depends on the emotional state; for example, it increases in women with symptoms of depression, whereas it increases in men when they do not have symptoms of depression [38]. The above discussion is beyond the scope of this study. The greatest decrease was observed in the 18- to 24-year-old age group, which may have occurred because adolescents have the highest consumption of soda and snacks in general [39,40]. In addition, 18 to 24 years is the age group where messages and media actions have traditionally focused [41,42]. Clearly, as food habits are established with age, the decrease in the SP consumption is lower.

The finding that the SP consumption decreased more in tall subjects, those with a better BMI, households with food security, and the most educated and wealthiest illustrates several novel phenomena: a) inequality exists when incorporating better decisions
regarding the purchase and consumption of foods that are negatively related to the state of health; b) subjects with greater “capacities/resources” translate information into better decisions [43,44]; c) it is possible that the consumption of the SP in the wealthiest and most educated is a result of having a sweet-tooth and therefore dispensable, whereas in the poorest, this consumption is part of the diet and therefore less expendable; d) the wealthy abandon snacks and likely increase their fruit-vegetable/fiber consumption; e) it is possible that in the poorest, the cost of the basic food basket increases significantly, which causes them to substitute snack foods for other foods more dense in nutrients, such as fruits, vegetables or milk, but which are also more expensive [45]; and finally f) the geographic region behaves as a proximal variable or cluster of economic and structural development and illustrates the same findings at the ecological level and the individual level: there is a gradient in the decrease in the SP consumption as the level of human and economic development in the regions increases.

Despite the effort made by the transnationals and snack producing and distributing companies to introduce snack consumption in rural areas [46], consumption still predominantly occurs in urban areas, which is why the greatest decrease was observed in those areas. This is corroborated indirectly by the result of snack consumption in the indigenous population (Table 1), which inhabits predominantly rural and dispersed areas. The decrease in SP can be explained in part by a local and mediatic phenomenon derived from the attempt to reduce soda consumption [37] and, in general, by the incorporation of messages against the consumption of sugar, packaged foods, sweets, and candy in favor of a healthy diet, which do not escape globalization. Currently, due to the media, it is impossible to think that we do not have permanent campaigns against and in favor of a healthy diet [47]. The decrease in the consumption of some of the items that comprise the traditional pattern/starch, panela [unrefined whole cane sugar], sugar, honey, and tubers
or bananas also suggests that the subjects associate snack and starch consumption with overweight and obesity, which is an association that, among others, was the axis of the aforementioned media campaigns.

Implications of change in the SP. The evidence of a food transition that coexists with the nutritional transition allows for a better understanding of the latter [48]. The implications of changes in SP adherence are difficult to anticipate, and their effects require time to be observed. In Chile, for example, the study of food change raises the need to rethink the relationship between industry, government, and the health of the population [49]. In Mexico, the food transition they experience is hypothesized to result in changes in the incidence of mediators of chronic disease such as hypertension [6]. For the first time, the US has substantially decreased the consumption of calories derived from SSB and snacks [27]. In Colombia, the bidirectional relationship between BMI and dietary consumption leads us to believe that the overweight pandemic will not reach the figures or stages known in more developed societies [14]. The food transition established in the SP will allow the establishment of new strategies to control the excess of weight in the subjects and enriches the context of the nutritional transition experienced in the 21st century by developing countries such as Colombia.

Scope and limitations of the study
The results of this study are unable to establish causal relationships; therefore, the decrease in the consumption of SP, panela, sugar, honey, tubers, and plantains may be due to a systematic information bias. However, given the independence in food patterns and that the results are consistent with other food transitions - where the richest migrate toward consumptions valued as healthy, such as fruits and vegetables, and are coherent with the phenomenon of the nutritional transition that was recently explained for this same population - obesity increases faster in the urban poor and residents [48] - the
ocurrence of this bias is unlikely. The main strength of this study is that it used data on dietary consumption that were comparable between periods and obtained in two representative national surveys.

Conclusions

In summary, there are three food consumption patterns in Colombia, and we demonstrate the transition that occurs in the SP. Both at an individual and ecological level, the region, the wealthiest, the tallest, the best BMI and the most educated displayed the greatest decrease in the SP. It is plausible that both local and global media messages and campaigns, which did not obey state policies, have influenced this decrease in SP consumption in Colombia. Identifying the causes and the context in which this decrease occurred can help develop adequate policies and interventions to sustain this decline.

List Of Abbreviations

SP: Snack Pattern

FFQ: Food Frequency Questionnaire

BMI: Body Mass Index

SCF: Subcutaneous Fat

SSB: Sugar Sweetened Beverages

ICBF: Colombian Family Welfare Institute

ENSIN: National Surveys of the Nutritional Situation

ELCSA: Latin American and Caribbean Scale of Food Security

WHO: World Health Organization

Declarations

Ethics approval and consent to participate.

The research was conducted in accordance with guidelines laid down by the Declaration of
Helsinki. Consent for participation in the surveys was obtained by the Colombian Institute of Family Welfare prior to enrollment (Instituto Colombiano de Bienestar Familiar –ICBF). The ethics committee in health research at the Industrial University of Santander determined that the analyzes of these de-identified data were exempt from review.

Consent for publication.
Not applicable

Availability of data and materia.
The databases that allowed this analysis are available for public access and can be obtained by requesting them from the Ministry of Public Health of Colombia. The data generated and analyzed for the current study are available at reasonable request to the corresponding author.

Competing interests.
The authors declare that they have no competing interests

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Authors’ contribution.
OFH designed the study, obtained the databases of the ICBF, prepared the databases and conducted and led statistical analyzes. OFH, EV and DCQ-L interpreted the results, prepared, reviewed and wrote the manuscript finally submitted. All authors reviewed the manuscript and approved the final version.

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The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported. The reporting of this work is compliant with STROBE guidelines. The lead author affirms that no important aspects of the study have been omitted. In addition, this study is a product of analysis of secondary information anonymized, public and available in different web pages properly reported within the main text and the references section.

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### Tables

**Table 1** Differences adjusted to the score of adherence to the Snack food consumption pattern (Z score). Colombian children (5 to 17 y) in 2010 and 2015.

| Variable                      | 2010 n* | Mean | SE  | \( P \) value | 2015 n* | Mean | SE  | \( P \) value | Adjusted difference 2015-2010 | \( P \) Interaction |
|-------------------------------|---------|------|-----|----------------|---------|------|-----|----------------|--------------------------|-------------------|
| **Sex**                      |         |      |     |                |         |      |     |                |                          |                   |
| Male                         | 515     | 0.66 | 0.02| 0.37           | 5       | 0.29 | 0.04| 0.01           | -0.40 (-0.46, -0.34)    | <0.000            |
| Female                       | 4       | 0.68 | 0.02|                | 3       | 0.35 | 0.04|                | -0.34 (-0.40, -0.28)    |                   |
| **Age group (y)**            |         |      |     |                |         |      |     |                |                          |                   |
| Children (5-10)              | 379     | 0.53 | 0.02| <0.0           | 401     | 0.21 | 0.04| 0.01           | -0.36 (-0.43, -0.30)    | <0.000            |
| Teenagers (11-17)            | 635     | 0.75 | 0.02|                | 861     | 0.41 | 0.04|                | -0.37 (-0.44, -0.31)    |                   |
| **Age (y)**                  |         |      |     |                |         |      |     |                |                          |                   |
| 5-8                          | 248     | 0.51 | 0.02| <0.0           | 327     | 0.21 | 0.05| 0.01           | -0.35 (-0.42, -0.28)    | <0.000            |
| 9-11                         | 1       | 0.57 | 0.03|                | 4       | 0.25 | 0.04|                | -0.36 (-0.44, -0.28)    |                   |
| 12-15                        | 194     | 0.78 | 0.02|                | 209     | 0.44 | 0.04|                | -0.38 (-0.46, -0.31)    |                   |
| 16-17                        | 9       | 0.74 | 0.03|                | 0       | 0.40 | 0.04|                | -0.36 (-0.45, -0.28)    |                   |
| **Stunting** (Height/Age)    |         |      |     |                |         |      |     |                |                          |                   |
| No                           | 882     | 0.69 | 0.01| <0.0           | 120     | 0.34 | 0.04| 0.01           | -0.37 (-0.42, -0.30)    | <0.000            |
| Yes (Z<-2)                   | 0       | 0.51 | 0.04|                | 10      | 0.08 | 0.05|                | -0.42 (-0.54, -0.31)    |                   |
| **Nutritional status** (BMI) |         |      |     |                |         |      |     |                |                          |                   |
| No                           | 419     | 0.79 | 0.02| 0.06           | 110     | 0.33 | 0.04| 0.01           | -0.40 (-0.47, -0.33)    | <0.000            |
| Overweight (>25)             | 736     | 0.65 | 0.08|                | 169     | 0.37 | 0.09|                | -0.43 (-0.54, -0.31)    |                   |
| Obesity (≥30)                | 201     | 0.65 | 0.08|                | 1       | 0.37 | 0.09|                | -0.31 (-0.51, -0.10)    |                   |
| **Household food insecurity**|         |      |     |                |         |      |     |                |                          |                   |
| No                           | 300     | 0.82 | 0.02| <0.0           | 410     | 0.37 | 0.04| 0.01           | -0.46 (-0.53, -0.38)    | <0.000            |
| Light                        | 376     | 0.56 | 0.03|                | 468     | 0.37 | 0.04|                | -0.36 (-0.43, -0.30)    |                   |
| Moderate                     | 8       | 0.52 | 0.04|                | 6       | 0.31 | 0.08|                | -0.31 (-0.39, -0.22)    |                   |
| Severe                       | 197     | 0.52 | 0.04|                | 251     | 0.31 | 0.08|                | -0.31 (-0.40, -0.22)    |                   |
| **Wealth index quintile**    |         |      |     |                |         |      |     |                |                          |                   |
| 1- poorest                   | 359     | 0.33 | 0.02| <0.0           | 283     | -0.0 | 0.04| 0.01           | -0.33 (-0.41, -0.25)    | <0.000            |
| 2                            | 246     | 0.82 | 0.03|                | 279     | 0.25 | 0.03|                | -0.30 (-0.39, -0.20)    |                   |
| 3                            | 2       | 0.82 | 0.03|                | 4       | 0.36 | 0.04|                | -0.38 (-0.46, -0.29)    |                   |
| 4                            | 181     | 0.93 | 0.04|                | 276     | 0.45 | 0.05|                | -0.38 (-0.46, -0.29)    |                   |
Table 2 Differences adjusted to the score of adherence to the Snack food consumption pattern (Z score). Colombian adults (18-64y) in 2010 and 2015.

| Variable   | 2010      | 2015      | Adjusted difference† | P Interation |
|------------|-----------|-----------|-----------------------|--------------|
|            | n* | Mean | SE | P value | n* | Mean | SE | P value |          |          |
| Sex        |     |      |    |         |     |      |    |         |          |          |
| Male       | 230 | 0.1  | 0.0 | 0.00    | 423 | -0.1 | 0.0 | 0.00    | -0.32 (-0.38, -0.26) | <0.0001   |
| Female     | 3  | 2    | 3   | 1       | 6  | 6    | 3   | 1       | -0.24 (-0.28, -0.26) | <0.0001   |
| Age (years)|     |      |    |         |     |      |    |         |          |          |
| 18-24      | 112 | 0.6  | 0.0 | 0.00    | 180 | 0.1  | 0.0 | 0.00    | -0.52 (-0.63, -0.41) | <0.0001   |
| 25-34      | 4   | 2    | 5   | 1       | 6  | 4    | 4   | 1       | -0.24 (-0.28, -0.26) | <0.0001   |

* In 2010 n may be less than 10150 for missing values. In 2015 n may be less than 13243 for missing values. † Adjusted difference and 95% confidence interval achieved in a linear regression model with the score of adherence (Z score) to the snack pattern as a dependent variable and predictors that include indicator variables for each sociodemographic correlates, year 2015 (2010 as reference) and cross-product (interaction) terms between year and indicator variables of the correlate. In addition, the linear regression model was adjusted by the following covariables; sex, age, food security, wealth index, ethnicity, area and region. The complex sampling survey design was taken into account in all multivariate regression models. ‡ Based on equivalent cut-off points using the IOFT classification. § The rural category included suburban population centers close to small cities, towns in rural areas distant from small towns, and disperses or very distant from rural towns.
| Ethnicity       | quintile | security | food secure | insecurity | insecurity | insecurity | insecurity | insecurity |
|----------------|----------|----------|-------------|------------|------------|------------|------------|------------|
| Mestizo        | 139      | -0.2     | 157         | -0.4       | 0.0        | 0.0        | -0.16      | -0.06      |
| Black/Afro     | 51       | 0.0      | 805         | -0.2       | 0.0        | 0.0        | -0.4       | -0.02      |
| Indigenous     | 557      | 0.1      | 559         | 2.0        | 0.0        | 0.0        | -0.1       | -0.02      |

| Tall (cm)      |          |          |             |             |             |             |             |             |
|----------------|----------|----------|-------------|------------|------------|------------|------------|------------|
| <150           | 609      | -0.9     | 0.0         | 0.0        | 0.0        | 0.0        | -0.4       | -0.4       |
| 150-159.9      | 195      | 1.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 160-169.9      | 3        | -0.2     | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 170+           | 171      | 1.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |

| Body mass index|          |          |             |             |             |             |             |             |
|----------------|----------|----------|-------------|------------|------------|------------|------------|------------|
| <18            | 139      | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 18-24.9        | 241      | 1.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 25-29.9        | 9        | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 30+            | 184      | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |

| Marital status|          |          |             |             |             |             |             |             |
|----------------|----------|----------|-------------|------------|------------|------------|------------|------------|
| Married/Living| 314      | -0.1     | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| together       | 0        | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| Unmarried/single| 204     | 0.2      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |

| Food security  |          |          |             |             |             |             |             |             |
|----------------|----------|----------|-------------|------------|------------|------------|------------|------------|
| Food secure    | 194      | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| Mild food      | 7        | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| insecurity     | 193      | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| Moderate food  | 7        | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| Severe food    | 754      | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| insecurity     | 505      | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |

| Wealth index   |          |          |             |             |             |             |             |             |
|----------------|----------|----------|-------------|------------|------------|------------|------------|------------|
| quintile       | 139      | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 1- poorest     | 9        | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 2              | 119      | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 3              | 6        | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 4              | 105      | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 5- wealthiest   | 3        | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |

| Ethnicity      |          |          |             |             |             |             |             |             |
|----------------|----------|----------|-------------|------------|------------|------------|------------|------------|
| Mestizo        | 403      | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.16      | -0.06      |
| Black/Afro     | 3        | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.02      |
| Indigenous     | 557      | 0.1      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.02      |

| Talla (cm)     |          |          |             |             |             |             |             |             |
|----------------|----------|----------|-------------|------------|------------|------------|------------|------------|
| <150           | 606      | -0.9     | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 150-159.9      | 195      | 1.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 160-169.9      | 3        | -0.2     | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 170+           | 171      | 1.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |

| Wealth index   |          |          |             |             |             |             |             |             |
|----------------|----------|----------|-------------|------------|------------|------------|------------|------------|
| quintile       | 139      | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 1- poorest     | 9        | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 2              | 119      | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 3              | 6        | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 4              | 105      | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| 5- wealthiest   | 3        | 0.0      | 0.0         | 0.0        | 0.0        | 0.0        | -0.1       | -0.1       |
| Area       | Education of the head | Preschool or less | Primary | Secondary | Post-secondary |
|------------|-----------------------|-------------------|---------|-----------|----------------|
| Urban      | 360                   | 0.2               | 0.0     | 42        | 0.0            | 88              | -0.13 (-0.36, 0.10) |
| Rural ‡    | 221                   | 0.1               | 0.0     | 21        | 0.0            | 2               | -0.15 (-0.20, -0.11) |
|            | 6                     | -0.1              | 0.0     | 3         | -0.2           | 2               | -0.33 (-0.40, 0.27)  |
|            | 170                   | 0.1               | 0.0     | 1         | -0.1           | 0.0             | -0.44 (-0.54, 0.33)  |
|            | 8                     | 4                 | 3       | 6         | 6              | 2               | -0.0              |
|            | 680                   | 0.1               | 0.0     | 1         | -0.4           | 0.0             | -0.44 (-0.54, 0.33)  |
|            | 7                     | 4                 | 3       | 6         | 6              | 2               | -0.33 (-0.40, 0.27)  |

| Region     | Education of the head | Preschool or less | Primary | Secondary | Post-secondary |
|------------|-----------------------|-------------------|---------|-----------|----------------|
| Central    | 364                   | 0.1               | 0.0     | 000       | -0.1           | 0.0             | -0.28 (-0.32, -0.24) |
| Atlantic   | 3                     | 0                 | 2       | 1         | 3              | 7               | -0.18 (-0.24, -0.12) |
| Oriental   | 113                   | 0.1               | 0.0     | 213       | -0.1           | 0.0             | -0.16 (-0.27, -0.05) |
| Pacific    | 3                     | 0                 | 3       | 6         | 6              | 4               | -0.31 (-0.38, -0.23) |
| Bogotá     | 681                   | -0.0              | 0.0     | 172       | -0.1           | 0.0             | -0.16 (-0.27, -0.05) |
| National   | 809                   | 6                 | 5       | 6         | 9              | 3               | -0.14 (-0.25, -0.04) |
| territories| 328                   | -0.1              | 0.0     | 120       | -0.2           | 0.0             | -0.14 (-0.25, -0.04) |
|            | 831                   | 6                 | 3       | 3         | 9              | 5               | -0.30 (-0.40, -0.20) |
|            | 0.1                   | 0.0               | 663     | -0.2      | 0.0            | 0.0             | -0.30 (-0.40, -0.20) |
|            | 4                     | 5                 | 141     | 4         | 0              | 0.0             | -0.30 (-0.40, -0.20) |
|            | -0.1                  | 0.0               | 7       | -0.3      | 0.0            | 0.0             | -0.32 (-0.42, -0.22) |
|            | 4                     | 3                 | 9       | 3         | 0.0            | 0.0             | -0.32 (-0.42, -0.22) |

* In 2010 n may be less than 5145 for missing values. In 2015 n may be less than 9443 for missing values. † Adjusted difference and 95% confidence interval achieved in a linear regression model with the score of adherence (Z score) to the snack pattern as a dependent variable and predictors that include indicator variables for each sociodemographic correlates, year 2015 (2010 as reference) and cross-product (interaction) terms between year and indicator variables of the correlate. In addition, the linear regression model was adjusted by the following covariables; sex, age, marital status, food security, wealth index, ethnicity, education of the head, area and region. The complex sampling survey design was taken into account in all multivariate regression models. ‡ The rural category included suburban population centers close to small cities, towns in rural areas distant from small towns, and disperses or very distant from rural towns.

**Figures**
Figure 1

Adherence to Snack food consumption pattern (Z) in Children 5 to 17y (a) and Colombian adults 18-64y (b); in 2010 ____ in 2015

Supplementary Files

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