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Diabetes and associated dietary intake among urban adults in Colombia: The Colombian Nutritional Profiles (COPEN) study

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ABSTRACT

Objectives: The prevalence of diabetes is increasing rapidly in developing countries. We aimed to estimate the prevalence of diabetes and to describe its main correlates and associated dietary intake in urban adults from Colombia.

Setting: The Colombian Study of Nutritional Profiles (COPEN) was a population-based, cross-sectional, multi-stage probabilistic sampling survey designed to represent the five main Colombian cities.

Participants: Between June and November 2018, we studied 736 non-pregnant participants aged 18 or older. Diabetes was defined as a random plasma glucose >= 200 mg/dL, self-reported prior diagnosis of diabetes or use of any oral or injectable antidiabetic agent(s). Participants also fulfilled a detailed 157-item food frequency questionnaire (FFQ).

Primary and secondary outcome measures: Prevalence of diabetes, dietary intake of key nutrients, achievement of dietary goals among individuals with diabetes.

Results: The overall estimated prevalence of diabetes was 10.1%, with no difference by sex (9.6% in women, 10.8% in men, p=0.43). Socioeconomic level (SEL) correlated positively with diabetes prevalence, the absolute difference in prevalence for the highest vs lowest SEL was 5.6%. The association between diabetes and education level depended on sex, diabetes was more prevalent among more educated men and less educated women. Abdominal obesity was associated with a 65% increase in diabetes prevalence among men, and a 163% increase in women. The proportion of non-achievement of dietary intake goals among participants with diabetes was 94.4% for saturated fats, 86.7% for sodium, 84.4% for fiber and 80% for trans fats. In multivariate logistical regression models, age was the strongest independent correlate of diabetes.

Conclusions

Self-reported diabetes was highly prevalent among Colombian adults, much more than described in most official reports. There were large differences by abdominal obesity status, region of

residence, SEL and educational level. The proportion of individuals with diabetes meeting dietary recommendations was alarmingly low.

Strengths and limitations of this study

1. What is already known about this subject?

The prevalence of diabetes is increasing rapidly all around the world, particularly in developing countries. Population-level data from Latin America are scarce and outdated.

2. What are the new findings?

The estimated prevalence of diabetes in Colombian urban adults was 10.1%. Diabetes was more frequent among more educated men and less educated women. Achievement of dietary recommendations for trans fats, fiber and sodium among individuals with diabetes was extremely low.

3. How might these results change the focus of research or clinical practice?

Governments from middle-income countries must urgently establish strategies for opportune detection and management of diabetes. A much greater emphasis must be placed on medical nutrition therapy for diabetes.

4. What are the main limitations of the study?

Random plasma glucose and self-reported diabetes may underestimate the real prevalence compared to OGTT of HbA1c. Nonetheless, even with such presumptive underestimation, diabetes was very frequent and achievement of dietary goals very low.

Data sharing statement

Extra data is available by emailing Dr. Carlos O. Mendivil: cmendivi@uniandes.edu.co

INTRODUCTION

The number of deaths attributed to diabetes in the year 2019 was 4.2 million, on average every eight seconds one person died from diabetes somewhere in the world (1). It is estimated that, if current trends persist, 700 million adults will live with diabetes by 2045 (2). As life expectancy increases, the number of older adults with diabetes will rise from 136 million to 276 million (1).

In South and Central America, the age-adjusted prevalence of diabetes has been estimated at 8.5% in 2019 and is expected to advance to 9.9% by 2045 (1,3). Brazil and Mexico, the most populated countries in the region, occupy respectively the fifth and sixth position in the ranking of countries with the most people with diabetes worldwide (1). The prevalence of diabetes varies widely across Latin American countries. Current data show that Puerto Rico and Mexico are the countries with the highest prevalence in the region (13.7% and 13.5% respectively), while Ecuador (5.5%) and Argentina (5.9%) have the lowest (1, 4-8). Latin America is the region where diabetes represents the largest proportion of total health expenditure (around 20% of total) (1). The cost of diabetes in Latin America and the Caribbean in 2015 was estimated at 103-142 billion dollars, a 6 to 7-fold increase relative to 2000 (9). Rapid urbanization and aging are the two main drivers of the diabetes epidemic in Latin America (10).

It is expected that, over the coming decades, the largest increase in people with diabetes will occur in countries experimenting the low to middle-income transition (1,11, 12). The Prospective Urban and Rural Epidemiology (PURE) study found that lower-income countries had the highest age and sex-adjusted prevalence of diabetes (average 12.3%), followed by upper-middle (average 11.1%,), lower-middle (average 8.7%) and high income countries (average 6.6%) (13).

Colombia is a South American country of about 48 million inhabitants, in which no recent population-based studies of diabetes prevalence or associated nutritional factors are available. In Colombia, the urbanization phenomenon has been further complicated by the internal displacement of hundreds of thousands of citizens as a result a protracted internal conflict that only came to an end in the recent years (14). The estimated cost of diabetes in Colombia is the fourth largest in the region below Brazil, Mexico and Venezuela (9). The official sources of information

about the burden of diabetes in Colombia are not population-based studies, but claim databases like the High-Cost Account (*Cuenta de Alto Costo* - CAC) (15), a registry kept by an association of Colombian health insurance companies. Another frequently cited source is SISPRO (*Sistema Integrado de Información de Protección Social* - Integrated Social Protection Information System) (www.sispro.gov.co/), a database that compiles all health services and procedures provided by the Colombian health system (16). These sources are useful for planning the provision of health services, but cannot provide estimations of diabetes and its associated factors at the population level. For instance, the CAC reported a diabetes prevalence of 2.2% between July 2016 and June 2017, a figure far removed from all worldwide data in similar countries and from IDF projections (1,5,17,18).

Colombia is a geographically, racially and culturally diverse country with marked differences among the five most populated regions: i. Central plateau (administrative and economic center of the country), ii. Caribbean region, with culture and costumes similar to those of Caribbean nations, iii. Pacific coast, a very industrialized region but also with high indexes of poverty and where most of the Afro-Colombian population resides, iv. Northwestern or “paisa” region, where there are many local traditions and there is a larger degree of European and Jewish ancestry and v. Northeastern/Andean region, mostly cold, very mountainous and with a larger degree of indigenous ancestry. Given that 81% of the Colombian population lives currently in urban centers, we aimed to estimate the prevalence of diabetes in a sample of adults from the main urban center in each of the five regions described above. The cities were Bogotá (Central plateau), Barranquilla (Caribbean region), Cali (Pacific region), Medellín (Northwest or "paisa" region) and Bucaramanga (Northeast/Andean region). We also assessed the association of diabetes status with demographics, anthropometry and nutrient intake, in the framework of the Colombian Study of Nutritional Profiles (Estudio Colombiano de Perfiles Nutricionales - COPEN).

METHODS

COPEN was a population-based, cross-sectional, multi-stage sampling survey designed to represent five cities, one from each of Colombia´s major regions. The sampling frame was obtained from the last census of the Colombian population, cartography was obtained from the national geostatistical frame developed by the Colombian National Department of Statistics (Departamento Administrativo Nacional de Estadística - DANE) and data on socioeconomic level (SEL) came from the National Superintendence of Public Services. In the first stage of sampling we selected cartographic sectors, within sectors we selected blocks (on average 8 per cartographic sector), within blocks we selected households, and within households we selected individual participants. Within each household, individuals were randomly selected employing a Kish grid. The sample was stratified by city, sex, age group and SEL. We excluded foreigners living in Colombia, individuals in hemodialysis or peritoneal dialysis therapy and persons with disabilities that precluded a reliable fulfillment of the study questionnaire. The complete study for COPEN was 1942 individuals, from which a random subsample of 736 non-pregnant participants aged 18 or older (representing 47.8% of all non-pregnant adults in COPEN) participated in the analyses reported in this paper.

Information was captured using a tablet device containing digital forms with proper validation rules, developed for the study. All staff in charge of data collection was extensively trained by the study Principal Investigator. A random 10% of participants were re-contacted by phone in order to double-check the accuracy of the information provided on date of birth, sex, city of residence, marital status, job status, educational level and date of initial contact. All data were collected between June and November 2018.

Patient and Public Involvement

Patients were not involved in the design of the study, but aggregated results will be presented to local and national authorities to inform public health policies concerning nutrition and primary prevention of diabetes.

Measurements

We collected information on sex, date of birth, SEL, marital status, educational level and employment status using a standardized questionnaire. The SEL that we employed for analyses was the one registered in DANE for that particular block. After a brief introduction about the importance of the accuracy of the measurements to be performed, we measured height and weight in all participants, and waist circumference in patients aged 18 and older. Height was measured using a portable stadiometer supported on a firm surface, taking care that the patient was barefoot, standing right and with heels and calves touching the stadiometer. Weight was measured in a solar digital scale with 100g sensitivity and 200 Kg capacity, all study scales were calibrated simultaneously the day before the study start, and every week afterwards. Waist circumference was measured by a sitting observer, directly over the participant´s skin, at the midpoint between the las rib and the anterosuperior iliac crest, using a flexible metallic measuring tape. All measurements were performed in duplicate, and if there was a between-measures discrepancy greater than 1 cm for height, 100g for weight or 1 cm for waist circumference, a third measurement was collected. For analyses we used the average of each anthropometric measure.

Socioeconomic level is classified in Colombia by the Statistics Department DANE in 6 strata according to characteristics of the residence (with stratum 1 being the lowest and stratum 6 being the highest) (19). Residential dwellings are classified according to their physical characteristics and environment. The methodology for this classification creates homogeneous strata taking as input information about land use, public utilities, access routes, topography, land valuation and property characteristics. The stratification unit is the sub-zone, corresponding generally to a block. Residential dwellings are classified in the predominant stratum of the sub-zone, as long as their characteristics do not differ ostensibly from the predominant conditions in the group. Otherwise, they are considered outliers and their stratum is assessed based on their particular characteristics. This information is very well established, updated and freely accessible for all the country. Given that sociodemographic, income and human development indicators are more similar for individuals living in strata 4 to 6 than among the other strata (19), we analyzed SEL in three groups, corresponding to strata 1-2 (low SEL), 3 (medium SEL) and 4-6 (high SEL). We interpreted BMI according to the cut points proposed by the World Health Organization (WHO): Underweight (BMI<18.5 Kg/m2), normal weight (BMI >=18.5 and <25 Kg/m2), overweight (BMI>=25 and

<30 Kg/m2) and obesity (BMI>=30 Kg/m2). We defined abdominal obesity as a waist circumference >= 90cm for women, and >= 94cm for men, according to the proposed cutoffs for Latin American adults (20).

Capillary blood specimens were collected by trained staff following standardized procedures, blood glucose levels were promptly measured and registered using an Accu-Check meter. Since fasting could not be guaranteed, we considered that an individual had diabetes if he/she met one of these three conditions: 1. A capillary blood glucose level >= 200 mg/dL, 2. A self-reported prior diagnosis of diabetes or 3. Self-reported use of any oral or injectable antidiabetic agent (s).

Usual dietary intake was assessed employing a 157-item semi-quantitative food-frequency questionnaire (FFQ). The FFQ was an enhanced and adapted version of an earlier FFQ specifically designed for the Colombian population (21). Portion sizes were established according to the reference unit most frequently consumed for each food. There were 9 possible ingestion frequencies: i. Never, ii. One to three times/month, iii. At least once/week, iv. Two to four times/week, v. Five to six times/week; vi. Once a day, vii. Two to three times a day, viii. Four to five times a day and ix. Six or more times a day. Participants were asked to make their selections based on their usual intake over the last year. FFQs were individually administered by study staff. The nutrient contribution of each food was calculated according to composition tables by the Colombian Institute for Family Welfare (Instituto Colombiano de Bienestar Familiar - ICBF), the United States Department of Agriculture and manufacturer´s information.

Data analysis

All prevalence estimations were projected to the target study population using city, sex, age group and SEL-specific expansion factors according to the study multi-stage sampling design. We did not have any missing data points. The univariate associations between nominal predictors and diabetes status were examined using chi-square independence tests. To test for a linear trend in the association between ordinal predictors and diabetes status, we report the p-value associated with a rank-correlation (Spearman) test between predictor and outcome. We also ran multivariable logistical models in which sociodemographic variables were the independent variables and diabetes status was the outcome.

In order to explore dietary intake and the achievement of dietary recommendations, we calculated for patients with diabetes the percent who met the protein (>=15% of daily caloric intake [DCI]), saturated fat (SFA) (<7% of DCI), monounsaturated fat (MUFA) (>=12% of DCI) and trans fat (<1g/day) recommendations set by the by the Latin-American Diabetes Association (22) and the fiber (14 g per each 1,000 Calories) and sodium (<2300 mg/day) goals set by the American Diabetes Association (23). All analyses were performed in SPSS for Windows, v.21 (Cary, NC, USA).

Ethical aspects

All participants provided written informed consent. All study procedures were performed according to the principles of the Helsinki Declaration, and to local rules and regulations as provided by Resolution 8430 of 1993 of the Colombian Ministry of Health. The study was approved by the IRB of Universidad de los Andes (Comité de Ética de la Vicerrectoría de Investigaciones), according to minute 1016 of April 27, 2018.

RESULTS

We studied 736 adults (45% men): 132 from Barranquilla, 250 from Bogotá, 86 from Bucaramanga, 126 from Cali and 142 from Medellin. Mean age was 46.1 +/- 17.6 years, about a third of participants were older than 60. Mean BMI was higher in women than men. There were similar proportions of single and married participants, while widowed or divorced individuals were the minority. There was approximately one third of the sample in each of the low, medium and high SEL categories. Only a fifth of study participants had a college or higher degree, and also about a fifth had only elementary or lower education (Table 1).

Table 1. Characteristics of the study sample. Educational level refers to the highest level completed. Socioeconomic level (SEL) according to Colombia´s official Statistics Department-DANE stratification scheme, using criteria about land use, public utilities, access routes, topography, land valuation and property characteristics of the property inhabited by the household. Low SEL includes strata 1 and 2, medium SEL includes only stratum 3, and high SEL includes strata 4, 5 and 6. Data are n (%).

		Men n=331	Women n=405	Total n=736
Age (years)	18-39	129 (39.0)	159 (39.3)	288 (39.1)
	40-59	108 (32.6)	127 (31.4)	235 (31.9)
	60-75	94 (28.4)	119 (29.4)	213 (28.9)
City	Barranquilla	66 (19.9)	66 (16.3)	132 (17.9)
	Bogotá	109 (32.9)	141 (34.8)	250 (34.0)
	Bucaramanga	38 (11.5)	48 (11.9)	86 (11.7)
	Cali	50 (15.1)	76 (18.8)	126 (17.1)
	Medellín	68 (20.5)	74 (18.3)	142 (19.3)
Marital status	Single	151 (45.6)	139 (34.3)	290 (39.4)
	Married/cohabitation	155 (46.8)	200 (49.4)	355 (48.2)
	Widowed/divorced	25 (7.6)	66 (16.3)	91 (12.4)
Educational level	Elementary or lower	66 (19.9)	90 (22.2)	156 (21.2)
	Secondary or technical	191 (57.7)	246 (58.2)	427 (58.0)
	Professional or higher	74 (22.4)	79 (19.5)	153 (20.8)
Socioeconomic level	Low	131 (39.6)	166 (41.0)	297 (40.4)
	Medium	98 (29.6)	121 (29.9)	219 (29.8)
	High	102 (30.8)	118 (29.1)	220 (29.9)

The overall estimated prevalence of diabetes was 10.1%, with no significant difference between sexes (9.6% in women, 10.8% in men, p=0.43). The prevalence was highest in Medellin (20.5%), followed by Cali (9.2%), Bogotá (8.1%), Barranquilla (8.0%) and Bucaramanga (7.4%). As expected, the prevalence of diabetes increased monotonically and significantly with age in both men and women (p-trend=0.001). For age groups 18-39 and 40-59, men had a numerically higher prevalence of diabetes than women, while in the 60-75 age group the opposite was true (Figure 1). The association between educational level and diabetes prevalence was dependent on sex. Among men, prevalence went from 7.0% for those with elementary education or lower, to 13.8% for those with a professional or higher degree. On the other hand, diabetes prevalence among women decreased steadily with higher education, going from 12.5% in the elementary or lower education group, to 7.2% in the professional or higher educational level group (Figure 2, panel A). Conversely, diabetes prevalence increased with SEL, so that prevalence in the highest SEL almost doubled that of the lowest SEL (Figure 1, panel B) (p-trend=0.04).

As expected, diabetes was more common as BMI increased, going from 8.0% in the normal/underweight category to 12.4% for obesity. While diabetes was almost equally prevalent among normal weight men and women, it was far more common in the male sex in the overweight and obesity categories (Figure 3, panel A). In males, the largest difference in prevalence was between normal weight and overweight, while for women the largest difference was between overweight and obesity. Abdominal obesity was also strongly associated with diabetes. The relative increase in diabetes prevalence for individuals with abdominal obesity vs. without it was 65% in men and 163% (2.63-fold) in women (Figure 3, panel B).

Unexpectedly, in analyses of dietary nutrient intake, people with diabetes reported a lower consumption of virtually all the nutrients. The mean reported daily caloric intake was significantly higher for people with diabetes. The same trend was observed for carbohydrates, total lipids, protein, SFA, MUFA, and polyunsaturated fats (PUFA), trans fats, cholesterol, sodium and fiber (Table 2).

Table 2. Daily intake of macronutrients, cholesterol, sodium and fiber, by diabetes diagnosis. SFA: Saturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA: Polyunsaturated fatty acids. Data are expanded group means.

	Diabetes diagnosis			
	No	Yes	Difference	p-value
Calories (Kg/day)	58.5	44.1	-14.4	<0.001
Carbohydrates (g/Kg/day)	7.08	5.18	-1.90	0.002
Protein (g/Kg/day)	2.03	1.72	-0.31	0.076
Lipids (g/Kg/day)	2.35	1.79	-0.56	<0.001
SFA (g/Kg/day)	0.73	0.58	-0.14	0.017
MUFA (g/Kg/day)	0.96	0.79	-0.17	0.01
PUFA (g/Kg/day)	0.56	0.39	-0.17	<0.001
Trans fatty acids (mg/day)	2.4	2.0	-0.41	0.005
Cholesterol (mg/day)	702.5	647.8	-54.7	0.75
Sodium (mg/day)	5330	3840	-1490	<0.001
Fiber (g/day)	37.9	33.2	-4.72	0.077

When assessing the compliance of self-reported nutrient intake with current guidelines, the proportion of people with diabetes not meeting the dietary goal for SFA was an alarming 94.4%. Goal non-achievement was similarly high for sodium (86.7%), dietary fiber (84.4%) and trans fats (80%). For protein and MUFA goals, these proportions were lower (45.6 and 16.7%, respectively).

In a mutually adjusted logistical model that included sex, age, city of residence, BMI, SEL and educational level as covariates, only age group ($p<0.001$) and city of residence ($p=0.019$) were significant predictors of diabetes status. The ORs relative to age group 18-39 were 2.12 (95% CI: 1.09-4.01) for age group 40-59 and 4.28 (95% CI: 2.24-8.19) for age group 60-75.

CONCLUSIONS

We performed a population-based study to describe diabetes prevalence and associated dietary nutrient ingestion patterns in five Colombian cities representing the main regions of the country. We found an overall prevalence of 10.1% based on self-reported diabetes and random plasma glucose measurements. Diabetes was more common with older age, higher SEL, excess body weight, abdominal obesity, and among residents of Medellin. The association between diabetes prevalence and education was dependent on sex: Inverse in women and direct in men. People with diabetes reported significantly less caloric intake than those without diabetes, this difference was also present for most macronutrients. When compared with current guidelines, the proportion of individuals with diabetes not achieving dietary recommendations for SFA, MUFA, trans fats, fiber and sodium among individuals with diabetes was remarkably high.

The reported prevalence of diabetes in Colombia varies widely across different studies and official documents, reflecting a lack of accurate population-level data, a problem common to many developing countries. The International Diabetes Federation Diabetes Atlas 2019 estimated an adjusted diabetes prevalence of 7.4% for the Colombian population (1), and the World Health Organization in its 2016 Diabetes Country Profiles reported a total prevalence of 8.0% (12). Meanwhile, the above-mentioned PURE study reported a prevalence of 11.1% for the population aged 35 to 70 from upper-middle income countries (13), much higher than the national survey done by Colombian government in 2007 (24), which found a 3.5% prevalence of self-reported diabetes in adults aged 18 to 69 (25). Results from regional studies are similarly heterogeneous. The CARMELA Study, a population-based study in large Latin American cities, found a diabetes prevalence of 8.1% in Bogotá in 2006 (26), similar to the 8.9% found in the Colombian Caribbean city of Cartagena in 2005 (27). A comparison of our findings with prior studies reveals that the diabetes epidemic seems to be progressing faster in smaller cities in Latin America. For example, diabetes prevalence in a 2006 study of adults in Bucaramanga was only 4%, while we found 7.4% in the same city (28). Overall, our study led to an estimate of diabetes prevalence much more plausible and coherent with international projections than data from existing national health surveys.

For the most part, the relationship between socioeconomic status and diabetes is consistent in high-income countries: a lower position increases risk (29,30-32). Meanwhile, the magnitude and direction of this association in middle- and low-income countries is conflicting across studies, perhaps due to imperfect data (33), but also because socioeconomic status is a complex construct for which different proxies are employed. A systematic review of studies restricted to lower and lower-middle income countries reported a positive association between socioeconomic status and diabetes risk (34). Similarly, data from the World Health Survey showed a positive correlation between diabetes and individual wealth in low-income countries, but in middle-income countries this trend disappeared after adjusting for relevant confounders (35). On the other hand, a stratified analysis of middle-income countries within a meta-analysis of 23 studies found an increased risk of type 2 diabetes in the lowest *versus* the highest socioeconomic status, be it measured by educational level, occupation or income (33). In Colombia, the positive association between diagnosed diabetes and SEL may be explained at least partially by increased access to medical care with higher income. Also, people insured by the subsidized health scheme (characteristically low-income individuals) and the uninsured have less access to diabetes screening (36).

There are precedents to our finding of an interaction between sex and educational level, so that more educated women had a lower prevalence of diabetes. A large multi-national study reported increasing odds of diabetes as BMI and education increased among men from middle-income countries. For women, the association was flat or slightly negative (37). Other studies of the associations between socioeconomic variables and diabetes have also found a different pattern according to sex (38, 39). Studies from Mexico (40) Argentina (41) and Brazil (42) have also documented higher rates of obesity and diabetes among more educated males and less educated females. Many factors could explain these results, but one that may apply to our context is a larger degree of body dissatisfaction among women, that increases with higher education. A study in Bogotá showed that women with higher education were more likely to identify thinner body silhouettes as their preferred ones (43). Our results complement a body of evidence suggesting that education of women may be a tool in the fight against the diabetes epidemic in developing countries.

We were surprised to find a lower self-reported weight-adjusted intake of calories and all macronutrients among patients with diabetes. An optimistic interpretation of this finding would be that it shows good adherence to dietary recommendations. However, such interpretation should be made with caution, as it is known that patients with diabetes and obesity frequently underreport their caloric intake (44). At the same time, the large proportion of participants with diabetes not meeting micronutrient recommendations is worrisome. An adequate intake of MUFA could aid in glycemic control (23), while a high intake of trans fats increases mortality and coronary heart disease risk (45). There is also clinical and mechanistic evidence showing that a high dietary intake of fiber favors glycemic control (23, 46). Lastly, clinical trials in patients with diabetes show that limitation of dietary sodium decreases blood pressure in a clinically significant manner (50). Nutritional education of patients with diabetes in developing countries is an urgent measure with large potential benefits and minimal risks.

Limitations of our study include the entirely urban sample, given the recent increase in obesity rural areas in the region (47) and Colombia (48). It is important, however, that the proportion of total population living in urban centers is in Colombia is 77.1% (49), a result of accelerated urbanization induced by years of internal conflict that has impacted the epidemiologic profile of the country (14). Another relevant limitation was the unavailability of oral glucose tolerance test (OGTT) data. OGTT is the most sensitive test for diabetes diagnosis but performing it would have imposed great complexities on the logistics of the study. We acknowledge that the prevalences we report, high as they seem, are most likely an underestimation.

In summary, our results confirm a continued progression of the diabetes epidemic in middle-income countries, and its relationship with demographic and socioeconomic factors. We also found remarkably low rates of achievement of key nutritional goals among patients with diabetes. Further research focused in rural areas is needed in order to build a complete the picture of evolution of the diabetes epidemic in the developing world.

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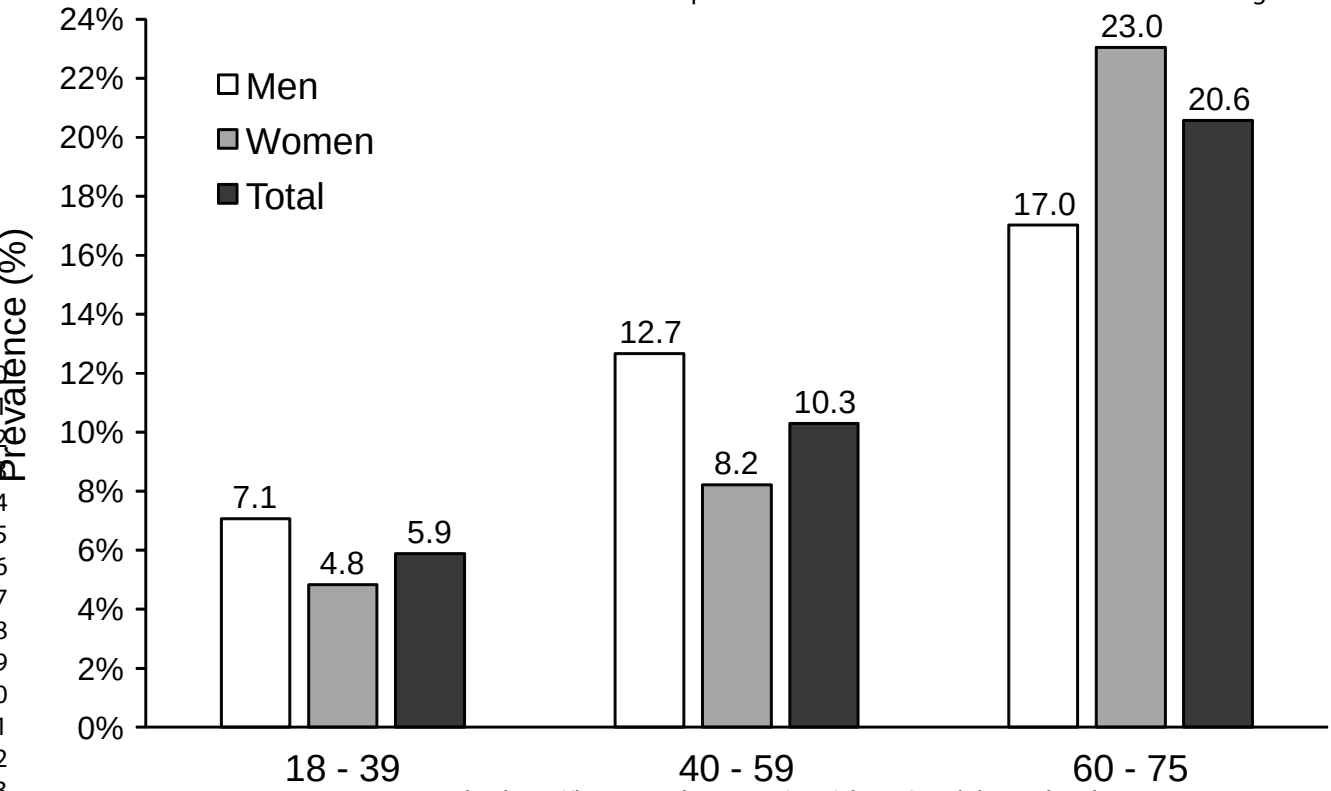
Figure legends

Figure 1. Prevalence of diabetes, by age and sex. Data are expanded group prevalences. P-value for the overall difference in prevalence among age groups <0.001. P-value for the trend in diabetes prevalence with increasing age group <0.001.

Figure 2. Prevalence of diabetes, by educational level (Panel A) and socioeconomic level (Panel B), and sex. Educational level refers to the highest level completed. Socioeconomic level (SEL) was classified according to Colombia´s official Statistics Department-DANE stratification scheme. Low SEL includes strata 1 and 2, medium SEL includes only stratum 3, and high SEL includes strata 4, 5 and 6. Data are expanded group prevalences. P-value for the overall difference in diabetes prevalence among socioeconomic levels=0.11. P-value for the trend in diabetes prevalence with increasing socioeconomic level=0.04.

Figure 3. Prevalence of diabetes, by body-mass index (Panel A) and waist circumference (Panel B) status. Underweight was defined as a body mass index (BMI) of less than 18.5 Kg/m^2, normal weight as a BMI between 18.5 and less than 25 Kg/m^2, overweight as a BMI between 25 and less than 30 Kg/m^2, and obesity as a BMI of 30 or higher. Abdominal obesity was defined as a waist circumference of 90 cm or higher in women, and 94 cm or higher in men. Data are expanded group prevalences.



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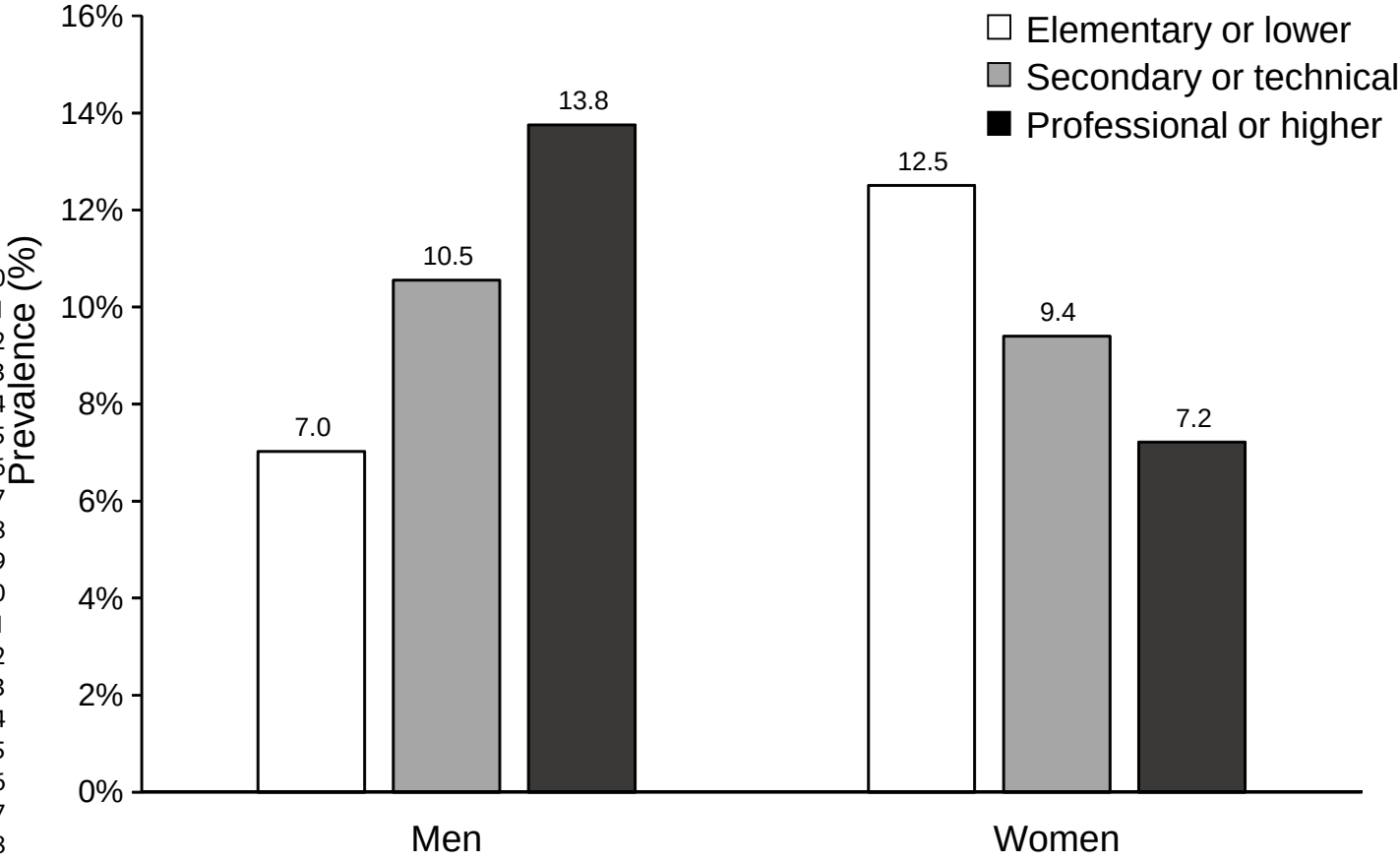

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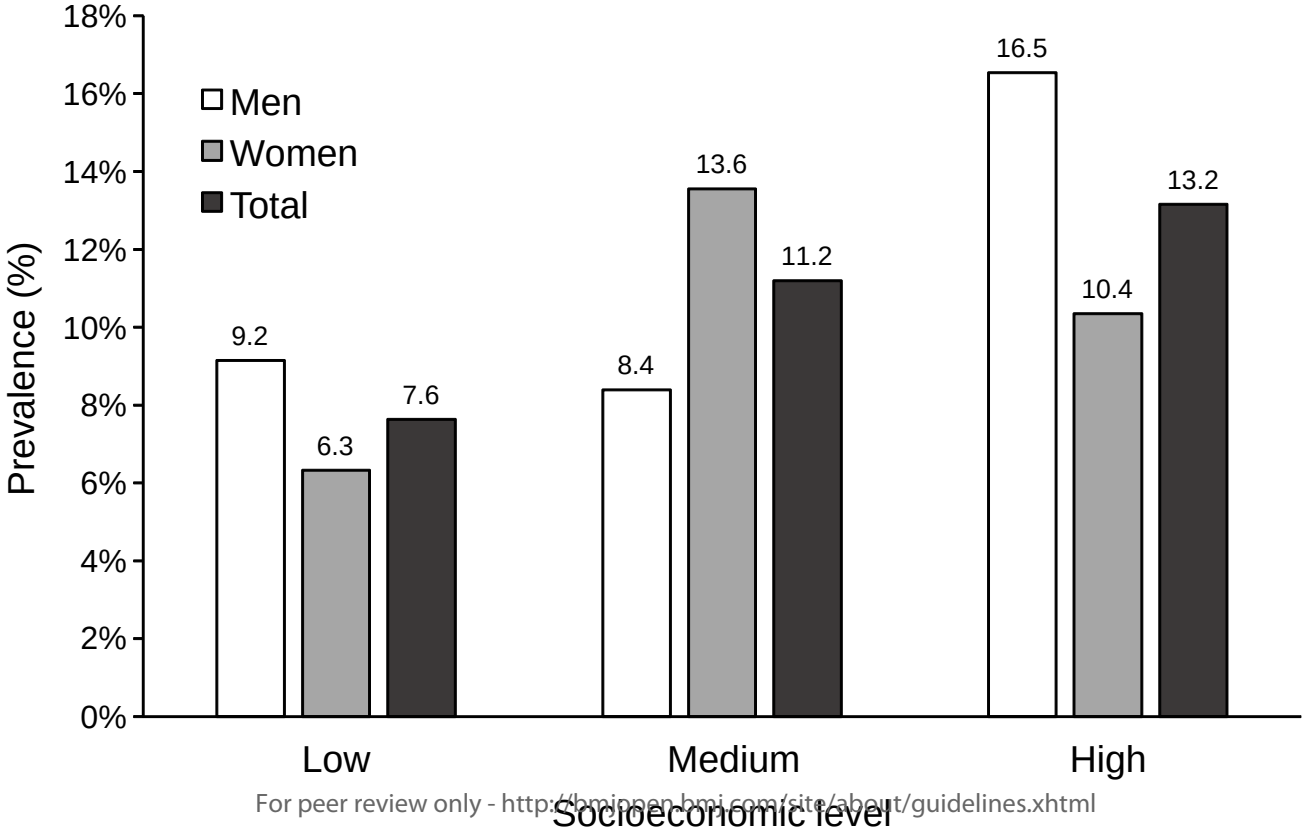

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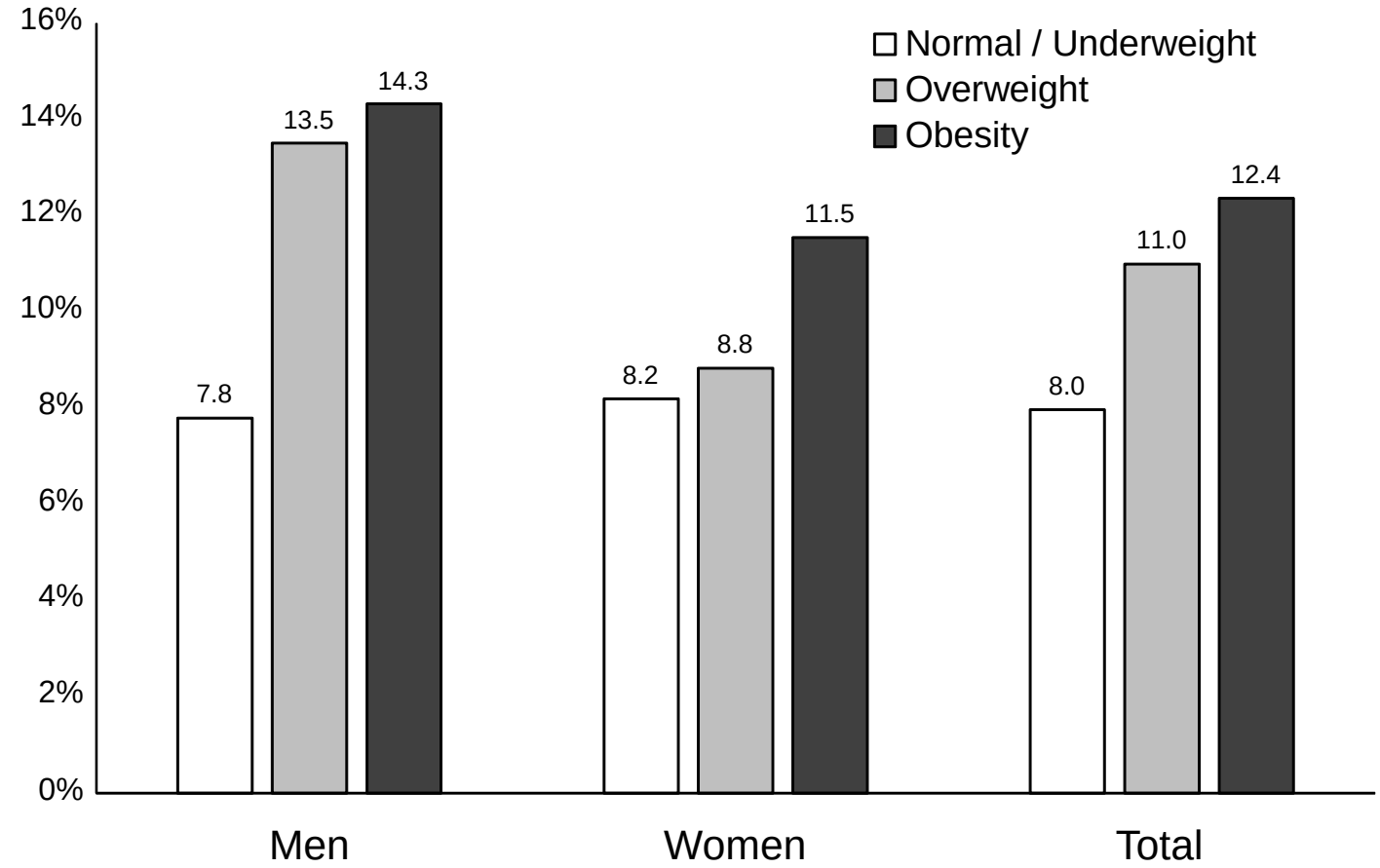

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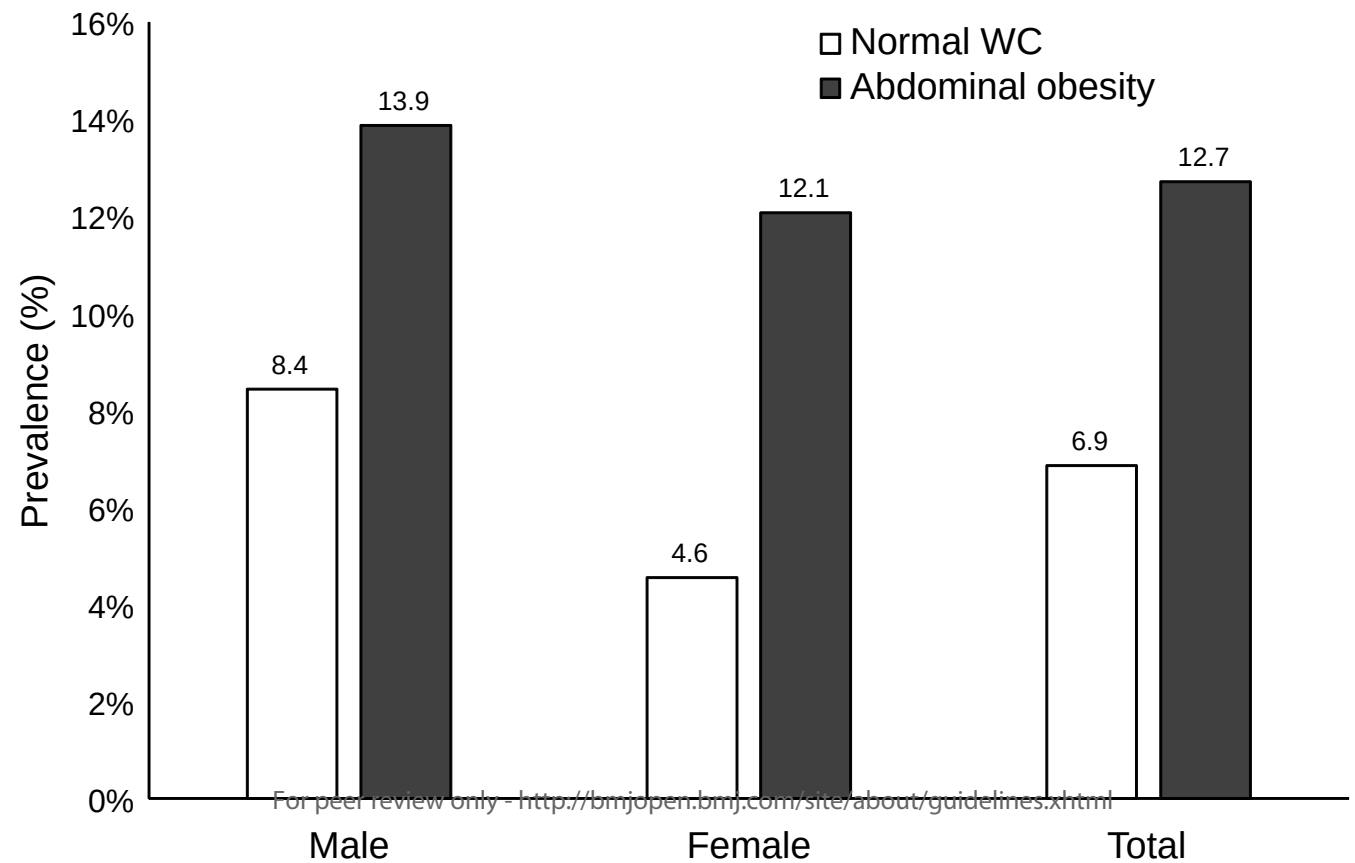

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Diabetes and associated dietary intake among urban adults: COPEN (Colombian Nutritional Profiles), a cross-sectional study

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ABSTRACT

Objectives: The prevalence of diabetes is increasing rapidly in developing countries. We aimed to estimate the prevalence of diabetes, to describe its main correlates and its associated dietary intake in urban adults from Colombia.

Setting: The Colombian Study of Nutritional Profiles (COPEN) was a population-based, cross-sectional, multi-stage probabilistic sampling survey designed to represent the five main Colombian cities.

Participants: Between June and November 2018, we studied 736 non-pregnant participants aged 18 or older. Diabetes was defined as a random plasma glucose >= 200 mg/dL, self-reported prior diagnosis of diabetes or use of any oral or injectable antidiabetic medication(s). Participants also fulfilled a detailed 157-item food frequency questionnaire (FFQ).

Primary and secondary outcome measures: Prevalence of diabetes, dietary intake of key nutrients, achievement of dietary goals among individuals with diabetes.

Results: The overall estimated prevalence of diabetes was 10.1%, with no difference by sex (9.6% in women, 10.8% in men, p=0.43). The association between diabetes and education level depended on sex, diabetes was more prevalent among more educated men and less educated women. Abdominal obesity was associated with a 65% increase in diabetes prevalence among men, and a 163% increase in women. Individuals with diabetes reported lower mean consumption of all nutrients, but after multivariate adjustment only their lower sodium consumption remained significant (p=0.013). The proportion of non-achievement of dietary intake goals among participants with diabetes was 94.4% for saturated fats, 86.7% for sodium, 84.4% for fiber and 80% for trans fats. In multivariate logistical regression models, age was the strongest independent correlate of diabetes.

Conclusions

Self-reported diabetes was highly prevalent among Colombian adults, much more than described in most official reports. There were large differences by abdominal obesity status, region of

residence, SEL and educational level. The proportion of individuals with diabetes meeting dietary recommendations was alarmingly low.

Strengths and limitations of this study

- The study explored the prevalence of self-reported diabetes and its associated dietary nutrient intake, as well as their relationship to key demographic factors.

- The study had a population-based, probabilistic sample from five cities in Colombia.

- Dietary intake was assessed with a food frequency questionnaire adapted to national and regional dietary habits, and inquiring about usual behavior, rather than recent intake.

- Random plasma glucose and self-reported diabetes may underestimate the real diabetes prevalence compared to oral glucose tolerance tests or glycated hemoglobin measurement.

- Our study did not include any participants from rural areas, whose diabetes prevalence and associated diet may differ significantly from those of urban populations.

Data sharing statement

The study dataset and its associated variable definitions file have been publicly deposited in the dryad repository, they can be consulted under the following link: https://doi.org/10.5061/dryad.sqv9s4n2n

INTRODUCTION

The number of deaths attributed to diabetes in the year 2010 was 3.96 million, on average every eight seconds one person died from diabetes somewhere in the world (1). It is estimated that, if current trends persist, 700 million adults will live with diabetes by 2045 (2). As life expectancy increases, the number of older adults with diabetes will rise from 136 million to 276 million (2).

In South and Central America, the age-adjusted prevalence of diabetes has been estimated at 8.5% in 2019 and is expected to advance to 9.9% by 2045 (2,3). Brazil and Mexico, the most populated countries in the region, occupy respectively the fifth and sixth position in the ranking of countries with the most people with diabetes worldwide (2). The prevalence of diabetes varies widely across Latin American countries. Current data show that Puerto Rico and Mexico are the countries with the highest prevalence in the region (13.7% and 13.5% respectively), while Ecuador (5.5%) and Argentina (5.9%) have the lowest (1, 4-8). Latin America is the region where diabetes represents the largest proportion of total health expenditure (around 20% of total) (2). The cost of diabetes in Latin America and the Caribbean in 2015 was estimated at 103-142 billion dollars, a 6 to 7-fold increase relative to 2000 (9). Rapid urbanization and aging are the two main drivers of the diabetes epidemic in Latin America (10).

It is expected that, over the coming decades, the largest increase in people with diabetes will occur in countries experimenting the low to middle-income transition (1,11, 12). The Prospective Urban and Rural Epidemiology (PURE) study found that lower-income countries had the highest age and sex-adjusted prevalence of diabetes (average 12.3%), followed by upper-middle (average 11.1%,), lower-middle (average 8.7%) and high income countries (average 6.6%) (13).

Colombia is a South American country of about 48 million inhabitants, in which no recent population-based studies of diabetes prevalence or associated nutritional factors are available. In Colombia, the urbanization phenomenon has been further complicated by the internal displacement of hundreds of thousands of citizens as a result a protracted internal conflict that only came to an end in the recent years (14). The estimated cost of diabetes in Colombia is the fourth largest in the region below Brazil, Mexico and Venezuela (9). The official sources of information

about the burden of diabetes in Colombia are not population-based studies, but claim databases like the High-Cost Account (*Cuenta de Alto Costo* - CAC) (15), a registry kept by an association of Colombian health insurance companies. Another frequently cited source is SISPRO (*Sistema Integrado de Información de Protección Social* - Integrated Social Protection Information System) (www.sispro.gov.co), a database that compiles all health services and procedures provided by the Colombian health system (16). These sources are useful for planning the provision of health services, but they cannot provide estimations of diabetes and its associated factors at the population level. For instance, the CAC reported a diabetes prevalence of 2.2% between July 2016 and June 2017, a figure far removed from all worldwide data in similar countries and from IDF projections (2,5,17,18). Similarly, these official sources based on care provision do not register relevant lifestyle variables, so they do not allow the exploration of dietary habits of people with diabetes in the general population. There are, however, some sources of estimates for the population prevalence of diabetes, but they are confined to a specific population group. Thus, the SABE (from the Spanish SAlud, Bienestar y Envejecimiento – Health, well-being and ageing) Colombia study found a rate of self-reported diabetes of 18.5% among adults aged over the age of 60 in 2015 (19). A similar prevalence (17.5%) was found in the SABE Bogotá survey of older adults in the country´s capital (20).

In Colombia, population-based surveys have demonstrated a notorious increase in both child and adult obesity over the last two decades (21). Such increases parallel those observed in Mexico and other Latin-American countries, suggesting that the recent phenomena of mass urbanization, westernization of dietary habits and adoption of sedentary behaviors are translating into a demographic and nutrition transition in the whole region (22). These changes have disproportionately affected more economically vulnerable segments of the population (23).

In addition to the recent rise in obesity, Colombia has also experienced a slow but sustained increase in life expectancy that started in the second half of the 20th century, especially among women (24). The combination of these factors greatly favors the development of diabetes and other chronic diseases, hence the exploration of the current of diabetes and its associated dietary behaviors is of great importance.

Dietary behavior is a crucial determinant of the degree of control and the development of chronic complications among individuals with diabetes. Dietary habits have a large impact on various parameters directly related to the risk of chronic complications, among them blood glucose levels, plasma lipids and blood pressure (25). Hence, the adequate documentation and exploration of the dietary habits of this population is of the utmost importance to guide clinical strategies and public health policies aimed at persons with diabetes. Despite the multiple combinations of macronutrients that may be adjusted to each person´s requirements and cultural preferences, most guidelines agree on a few universal goals whose attainment predicts a larger probability of diabetes control, and prevention of chronic complications (26). These goals usually comprise the distribution of calories among the different macronutrients, the restriction of dietary trans fats, sodium and cholesterol, and the provision of an adequate amount of dietary fiber.

Colombia is a geographically, racially and culturally diverse country with marked differences among the five most populated regions: i. Central plateau (administrative and economic center of the country), ii. Caribbean region, with culture and costumes similar to those of Caribbean nations, iii. Pacific coast, a very industrialized region but also with high indexes of poverty and where most of the Afro-Colombian population resides, iv. Northwestern or "paisa" region, where there are many local traditions and there is a larger degree of European and Jewish ancestry and v. Northeastern/Andean region, mostly cold, very mountainous and with a larger degree of indigenous ancestry. Given that 81% of the Colombian population lives currently in urban centers, we undertook a study in five cities, one from each region, in order to answer the following research question: What is the prevalence of self-reported diabetes in the main urban centers of Colombia, and how does the nutrient intake of these individuals compare to that of people without diabetes? An ancillary goal of the study was to explore to what extent do people with diabetes achieve the internationally recommended dietary goals for individuals with diabetes.

METHODS

COPEN (Estudio Colombiano de Perfiles Nutricionales – Colombian Study of Nutritional Profiles) was a population-based, cross-sectional, multi-stage sampling survey designed to represent five cities, one from each of Colombia´s major regions: Bogotá (Central plateau), Barranquilla (Caribbean region), Cali (Pacific region), Medellin (Northwest or "paisa" region) and Bucaramanga (Northeast/Andean region). The sampling frame was obtained from the last census of the Colombian population, cartography was obtained from the national geostatistical frame developed by the Colombian National Department of Statistics (Departamento Administrativo Nacional de Estadística - DANE) and data on socioeconomic level (SEL) came from the National Superintendence of Public Services. In the first stage of sampling we selected cartographic sectors, within sectors we selected blocks (on average 8 per cartographic sector), within blocks we selected households, and within households we selected individual participants. Within each household, individuals were randomly selected employing a Kish grid. The sample was stratified by city, sex, age group and SEL. With this design and including the design effect, the complete study sample yielded an overall sampling error of 2.2%. The sampling errors for each city were respectively: Bogotá 4.0%, Medellin 5.0%, Cali 5.0%, Barranquilla 5.6% and Bucaramanga 6.8%. We excluded foreigners living in Colombia, individuals in hemodialysis or peritoneal dialysis therapy and persons with disabilities that precluded a reliable fulfillment of the study questionnaire. The complete study for COPEN was 1942 individuals, from which a random subsample of 736 non-pregnant participants aged 18 or older (representing 47.8% of all non-pregnant adults in COPEN) participated in the analyses reported in this paper.

Information was captured using a tablet device containing digital forms with proper validation rules, developed for the study. All staff in charge of data collection was extensively trained by the study Principal Investigator. A random 10% of participants were re-contacted by phone in order to double-check the accuracy of the information provided on date of birth, sex, city of residence, marital status, job status, educational level and date of initial contact. All data were collected between June and November 2018.

Patient and Public Involvement

Patients and the public were not involved in the design of the study, but aggregated results will be presented to local and national authorities to inform public health policies concerning nutrition and primary prevention of diabetes.

Measurements

We collected information on sex, date of birth, SEL, marital status, educational level and employment status using a standardized questionnaire. Since diabetes incidence rises sharply at age 40 and peaks approximately at age 60 (27), age was operationalized for most analyses in three groups: 18-39, 40-59 and 60-75 years. The SEL that we employed for analyses was the one registered in DANE for that particular block. After a brief introduction about the importance of the accuracy of the measurements to be performed, we measured height and weight in all participants, and waist circumference in participants aged 18 and older. Height was measured using a portable stadiometer supported on a firm surface, taking care that the participant was barefoot, standing right and with heels and calves touching the stadiometer. Weight was measured in a solar digital scale with 100g sensitivity and 200 Kg capacity, all study scales were calibrated simultaneously the day before the study start, and every week afterwards. Waist circumference was measured by a sitting observer, directly over the participant´s skin, at the midpoint between the las rib and the anterosuperior iliac crest, using a flexible metallic measuring tape. All measurements were performed in duplicate, and if there was a between-measures discrepancy greater than 1 cm for height, 100g for weight or 1 cm for waist circumference, a third measurement was collected. For analyses we used the average of each anthropometric measure.

Socioeconomic level is classified in Colombia by the Statistics Department DANE in 6 strata according to characteristics of the residence (with stratum 1 being the lowest and stratum 6 being the highest) (28). Residential dwellings are classified according to their physical characteristics and environment. The methodology for this classification creates homogeneous strata taking as input information about land use, public utilities, access routes, topography, land valuation and property characteristics. The stratification unit is the sub-zone, corresponding generally to a block. Residential dwellings are classified in the predominant stratum of the sub-zone, as long as their characteristics do not differ ostensibly from the predominant conditions in the group. Otherwise, they are considered outliers and their stratum is assessed based on their particular characteristics.

This information is very well established, updated and freely accessible for all the country. Given that sociodemographic, income and human development indicators are more similar for individuals living in strata 4 to 6 than among the other strata (28), we analyzed SEL in three groups, corresponding to strata 1-2 (low SEL), 3 (medium SEL) and 4-6 (high SEL). We interpreted BMI according to the cut points proposed by the World Health Organization (WHO): Underweight (BMI<18.5 Kg/m2), normal weight (BMI >=18.5 and <25 Kg/m2), overweight (BMI>=25 and <30 Kg/m2) and obesity (BMI>=30 Kg/m2). We defined abdominal obesity as a waist circumference >= 90cm for women, and >= 94cm for men, according to the proposed cutoffs for Latin American adults (29).

Capillary blood specimens were collected by trained staff following standardized procedures, blood glucose levels were promptly measured and registered using an Accu-Check meter. Since fasting could not be guaranteed, we considered that an individual had diabetes if he/she met one of these three conditions: 1. A capillary blood glucose level >= 200 mg/dL, 2. A self-reported prior diagnosis of diabetes or 3. Self-reported use of any oral or injectable antidiabetic medication (s).

Usual dietary intake was assessed employing a 157-item semi-quantitative food-frequency questionnaire (FFQ). The FFQ was an enhanced and adapted version of an earlier FFQ specifically designed for the Colombian population (30). In a prior validation against four independent 24-hour dietary recalls, a shorter version of the FFQ showed a percent of classification in the same quartile of nutrient intake between 61 and 83%, and Pearson correlation coefficients between 0.51 for protein and 0.77 for carbohydrate (31). Portion sizes were established according to the reference unit most frequently consumed for each food. There were 9 possible ingestion frequencies: i. Never, ii. One to three times/month, iii. At least once/week, iv. Two to four times/week, v. Five to six times/week; vi. Once a day, vii. Two to three times a day, viii. Four to five times a day and ix. Six or more times a day. Participants were asked to make their selections based on their usual intake over the last year. FFQs were individually administered by study staff. The nutrient contribution of each food was calculated according to composition tables by the Colombian Institute for Family Welfare (Instituto Colombiano de Bienestar Familiar - ICBF), the United States Department of Agriculture and manufacturer´s information. The COPEN protocol and COPEN field materials (in Spanish) are provided as Supplementary Material 1 and 2, respectively.

Data analysis

All prevalence estimations were projected to the target study population using city, sex, age group and SEL-specific expansion factors according to the study multi-stage sampling design. We did not have any missing data points for sociodemographic factors, diabetes status and dietary intake variables. The univariate associations between nominal predictors and diabetes status were examined using chi-square independence tests. To test for a linear trend in the association between ordinal predictors and diabetes status, we report the p-value associated with a rank-correlation (Spearman) test between predictor and outcome. We also ran multivariable logistical models in which sex, age group, SEL and educational level were the independent variables and diabetes status was the outcome. We initially compared mean consumption of macronutrients and micronutrients of interest between individuals with or without diabetes using a one-way ANOVA, with diabetes as fixed factor. Since a higher BMI is associated with diabetes risk and also with a higher dietary nutrient intake, we also performed multivariable linear regression analyses in which age, sex, BMI, SEL and diabetes status were the predictors and the daily consumption of each nutrient was the dependent variable (one model per nutrient). We explored the achievement of dietary recommendations among individuals with diabetes, expressed as the percent of individuals with diabetes who met the protein (>=15% of total caloric intake [TCI]), saturated fat (SFA) (<7% of TCI), monounsaturated fat (MUFA) (>=12% of TCI) and trans fat (<1g/day) recommendations set by the by the Latin-American Diabetes Association (32) and the fiber (14 g per each 1,000 Calories) and sodium (<2300 mg/day) goals set by the American Diabetes Association (33). In order to explore factors associated with achievement of dietary goals, we also built a series of nested multivariable logistic models, in which achievement of each dietary goal was the outcome. Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model 3 had all variables in model 2 plus city, model 4 had all variables in model 3 plus BMI, and model 5 had all variables in model 4 plus diabetes status. All analyses were performed in SPSS for Windows, v.21 (Cary, NC, USA).

Ethical aspects

All participants provided written informed consent. All study procedures were performed according to the principles of the Helsinki Declaration, and to local rules and regulations as

provided by Resolution 8430 of 1993 of the Colombian Ministry of Health. The study was approved by the IRB of Universidad de los Andes (Comité de Ética de la Vicerrectoría de Investigaciones), according to minute 1016 of April 27, 2018.

RESULTS

We studied 736 adults (45% men): 132 from Barranquilla, 250 from Bogotá, 86 from Bucaramanga, 126 from Cali and 142 from Medellin. Mean age was 46.1 +/- 17.6 years, about a third of participants were older than 60. Mean BMI was higher in women than men. There were similar proportions of single and married participants, while widowed or divorced individuals were the minority. There was approximately one third of the sample in each of the low, medium and high SEL categories. Only a fifth of study participants had a college or higher degree, and about a fifth had only elementary or lower education (Table 1). Supplemental Figure 1 summarizes the scheme of participant recruitment for the study.

Table 1. Characteristics of the study sample.

		Men n=331 n (%)	Women n=405 n (%)	Total n=736 n (%)
Age (years)	18-39	129 (39.0)	159 (39.3)	288 (39.1)
	40-59	108 (32.6)	127 (31.4)	235 (31.9)
	60-75	94 (28.4)	119 (29.4)	213 (28.9)
City	Barranquilla	66 (19.9)	66 (16.3)	132 (17.9)
	Bogotá	109 (32.9)	141 (34.8)	250 (34.0)
	Bucaramanga	38 (11.5)	48 (11.9)	86 (11.7)
	Cali	50 (15.1)	76 (18.8)	126 (17.1)
	Medellin	68 (20.5)	74 (18.3)	142 (19.3)
Marital status	Single	151 (45.6)	139 (34.3)	290 (39.4)
	Married/cohabitation	155 (46.8)	200 (49.4)	355 (48.2)
	Widowed/divorced	25 (7.6)	66 (16.3)	91 (12.4)
Educational level	Elementary or lower	66 (19.9)	90 (22.2)	156 (21.2)
	Secondary or technical	191 (57.7)	246 (58.2)	427 (58.0)
	Professional or higher	74 (22.4)	79 (19.5)	153 (20.8)
Socioeconomic level	Low	131 (39.6)	166 (41.0)	297 (40.4)
	Medium	98 (29.6)	121 (29.9)	219 (29.8)
	High	102 (30.8)	118 (29.1)	220 (29.9)
BMI	(mean +/- SD)	25.9 +/- 4.7	28.0 +/- 6,5	27.1 +/- 5,8
Abdominal obesity (n=723)	Yes	166 (51.6)	118 (29.4)	284 (39.3)
	No	156 (48.4)	283 (70.6)	445 (60.7)

Educational level refers to the highest level completed. Socioeconomic level (SEL) according to Colombia´s official Statistics Department-DANE stratification scheme, using criteria about land use, public utilities, access routes, topography, land valuation and property characteristics of the property inhabited by the household. Low SEL includes

strata 1 and 2, medium SEL includes only stratum 3, and high SEL includes strata 4, 5 and 6. Data are n (%) unless indicated otherwise .

The overall estimated prevalence of diabetes was 10.1% +/- 3.2% (age-adjusted 9.44 +/- 3.0%), with no significant difference between sexes (9.6% +/- 4.3% in women, 10.8% +/- 4.7% in men; p=0.43, age-adjusted 9.5% +/- 4.1% in women, 9.2% +/- 4.0% in men). The prevalence was highest in Medellin (20.5% +/- 7.2%), followed by Cali (9.2% +/- 7.5%), Bogotá (8.1% +/- 5.3%), Barranquilla (8.0% +/- 7.9%) and Bucaramanga (7.4% +/- 9.9%). As expected, the prevalence of diabetes increased monotonically with age in both men and women (p for the difference among age groups and p-trend both<0.001). For age groups 18-39 and 40-59, men had a numerically higher prevalence of diabetes than women, while in the 60-75 age group the opposite was true (Figure 1). The association between educational level and diabetes prevalence was dependent on sex. Among men, prevalence went from 7.0% for those with elementary education or lower, to 13.8% for those with a professional or higher degree. On the other hand, diabetes prevalence among women decreased steadily with higher education, going from 12.5% in the elementary or lower education group, to 7.2% in the professional or higher educational level group (Figure 2, panel A). Conversely, diabetes prevalence increased with SEL, so that prevalence in the highest SEL almost doubled that of the lowest SEL (Figure 1, panel B) (P-value for the trend in diabetes prevalence with increasing socioeconomic level=0.04.).

Diabetes was more common as BMI increased, going from 8.0% in the normal/underweight category to 12.4% for obesity (p-trend <0.001). While diabetes was almost equally prevalent among normal weight men and women, it was far more common in the male sex in the overweight and obesity categories (Supplemental Figure 2, panel A). Abdominal obesity was strongly associated with diabetes. The relative increase in diabetes prevalence for individuals with abdominal obesity vs. without it was 65% in men and 163% (2.63-fold) in women (Supplemental Figure 2, panel B).

In a mutually adjusted logistical model that included sex, age, city of residence, BMI, SEL and educational level as covariates, only age group (p<0.001) and city of residence (p=0.019) were significant predictors of diabetes status. The ORs relative to age group 18-39 were 2.12 (95% CI: 1.09-4.01) for age group 40-59 and 4.28 (95% CI: 2.24-8.19) for age group 60-75. Despite the

notorious difference in diabetes prevalence between men and women depending on SEL and educational level, the respective interaction terms were not statistically significant (p=0.074 for the sex*SEL interaction, p=0.24 for the sex*educational level interaction term). In this model, the adjusted prevalence of diabetes was significantly higher among men than women in the low SEL (p=0.035).

Unexpectedly, in analyses of dietary nutrient intake, people with diabetes reported a lower consumption of virtually all the nutrients. Consequently, the mean reported daily caloric intake was significantly lower for people with diabetes. This trend was observed for carbohydrates, total lipids, protein, SFA, MUFA, and polyunsaturated fats (PUFA), trans fats, cholesterol, sodium and fiber (Supplemental Table 1). The mean daily consumption of trans fats by individuals with diabetes (2.0+/-1.2 g/day) was significantly lower than in individuals without diabetes (2.4+/-1.8 g/day, p=0.005), but still much higher than the recommended limit of maximum 1g/day. Similarly, persons with diabetes had a significantly lower intake of dietary sodium (3840+/-1913 mg/day *versus* 5330+/-2767 mg/day, p<0.001). People with diabetes showed a trend towards lower consumption of fiber, that did not reach statistical significance (33.2+/-14.1 g/day *versus* 37.9+/-16.9 g/day, p=0.077).

After adjusting for sex, age, SEL and BMI, the relative difference in nutrient intake between persons with versus without diabetes ranged between -2.7% for cholesterol and -24.7 for polyunsaturated fatty acids (Figure 3). After multivariate adjustment, however, only the lower consumption of sodium among individuals with diabetes retained statistical significance (p=0.013).

The macronutrient composition of the diet showed only small variations by diabetes status. For individuals with and without diabetes, the proportions of TCI from each macronutrient were, respectively: Carbohydrates 46.8% *versus* 48.3%, proteins 15.8% *versus* 14.2%, and lipids 36.5% *versus* 36.1%. Only the slightly higher proportion of TCI from protein was statistically significant (p<0.001) (Supplemental Figure 3, panel A). In terms of fat types, there were also very slight differences according to diabetes status. The proportions of TCI coming from each type of fat in individuals with *versus* without diabetes were, respectively: 11.7% versus 11.1% for SFA, 15.9%

versus 14.7% for MUFA and 8.1% versus 8.4% for PUFA (Supplemental Figure 3, panel B). The 1.8% higher TCI from MUFA in the diabetes group was statistically significant (p=0.031).

When assessing the compliance of self-reported nutrient intake with current guidelines, the proportion of people with diabetes not meeting the dietary goal for SFA was an alarming 94.4%. Goal non-achievement was similarly high for sodium (86.7%), dietary fiber (84.4%) and trans fats (80%). For protein and MUFA goals, these proportions were lower (45.6 and 16.7%, respectively).

The achievement of dietary goals was associated with demographic factors and with the presence of diabetes (Table 2). Men were much less likely to achieve the sodium (5.4% *versus* 11.4% in women) and fiber (8.5% versus 13.1% in women) recommendations. Participants aged 18 to 39 were less likely to meet the trans fats and sodium recommendations than their older counterparts. Achievement of the trans fats goal was lowest in Bogotá, while for sodium intake the lowest degree of achievement was found in Barranquilla (only 3.8%). Consumption of the recommended amount of dietary fiber was particularly low in Medellin (4.2%). The proportion of people from a high SEL meeting the SFA recommendation was also very low (2.3%). Despite the observed differences in mean nutrient intake between persons with or without diabetes, the degree of goal achievement was only markedly different for sodium (13.3% in diabetes *versus* 8.0 in no diabetes) and protein (54.4% in diabetes *versus* 36.4% in no diabetes).

Table 2. Proportion of individuals achieving different dietary recommendations, according to sex, age group, city, SEL and educational level.

		Trans fat <1g/day	Sodium <2300 mg/day	Protein >=15% of TCI	SFA <7% of TCI	MUFA >=12% of TCI	Fiber >=14 g / 1,000 Cal
Sex	Male n=331	66 (19.9%)	18 (5.4%)	129 (39%)	29 (8.8%)	246 (74.3%)	28 (8.5%)
	Female n=405	76 (18.8%)	46 (11.4%)	155 (38.3%)	29 (7.2%)	331 (81.7%)	53 (13.1%)
Age group	18 to 39 n=288	42 (14.6%)	14 (4.9%)	103 (35.8%)	20 (6.9%)	234 (81.3%)	14 (4.9%)
	40 to 59 n=235	52 (22.1%)	30 (12.8%)	101 (43%)	14 (6%)	179 (76.2%)	33 (14%)
	60 to 75 n=213	48 (22.5%)	20 (9.4%)	80 (37.6%)	24 (11.3%)	164 (77%)	34 (16%)
City	Bogotá n=250	37 (14.8%)	23 (9.2%)	97 (38.8%)	20 (8%)	205 (82%)	39 (15.6%)
	Medellin n=142	22 (15.5%)	12 (8.5%)	51 (35.9%)	8 (5.6%)	106 (74.6%)	6 (4.2%)
	Cali n=126	35 (27.8%)	13 (10.3%)	54 (42.9%)	11 (8.7%)	96 (76.2%)	15 (11.9%)
	Barranquilla n=132	24 (18.2%)	5 (3.8%)	44 (33.3%)	12 (9.1%)	109 (82.6%)	12 (9.1%)
	Bucaramanga n=86	24 (27.9%)	11 (12.8%)	38 (44.2%)	7 (8.1%)	61 (70.9%)	9 (10.5%)
SEL	Low n=297	67 (22.6%)	22 (7.4%)	96 (32.3%)	35 (11.8%)	218 (73.4%)	26 (8.8%)
	Medium n=219	37 (16.9%)	15 (6.8%)	82 (37.4%)	18 (8.2%)	170 (77.6%)	24 (11%)
	High n=220	38 (17.3%)	27 (12.3%)	106 (48.2%)	5 (2.3%)	189 (85.9%)	31 (14.1%)
Educational level	Elementary or lower n=156	45 (28.8%)	16 (10.3%)	53 (34%)	20 (12.8%)	104 (66.7%)	16 (10.3%)
	Secondary or technical n=427	73 (17.1%)	28 (6.6%)	158 (37%)	28 (6.6%)	339 (79.4%)	47 (11%)
	Professional or higher n=153	24 (15.7%)	20 (13.1%)	73 (47.7%)	10 (6.5%)	134 (87.6%)	18 (11.8%)
Diabetes	Yes n=90	18 (20%)	12 (13.3%)	49 (54.4%)	5 (5.6%)	75 (83.3%)	14 (15.6%)
	No n=646	124 (19.2%)	52 (8%)	235 (36.4%)	53 (8.2%)	502 (77.7%)	67 (10.4%)

Data are n (%).

In nested logistical models, the variables significantly associated with attainment of dietary recommendations were different for each goal in the fully adjusted model (Supplemental Table 2). Male sex showed a negative association with meeting the dietary recommendations for sodium (OR 0.46, 95%CI 0.25-0.82), MUFA (OR 0.60, 95%CI 0.41-0.87) and fiber (OR 0.58, 95%CI 0.35-0.96). On the other hand, age was positively associated with meeting the recommendations for TFA (OR 1.019 per year, 95%CI 1.007-1.031), sodium (OR 1.026 per year, 95%CI 1.008-1.044) and fiber (OR 1.036 per year, 95%CI 1.019-1.053). Participants from high SEL were more likely to meet the goals for protein (OR 2.01, 95%CI 1.38-2.93), but less likely to meet the goal for SFA (OR 0.16, 95%CI 0.06-0.42). Individuals with obesity were more likely to reach the dietary protein recommendation (OR 2.02, 95% CI 1.33-3.06). Participants from Cali or

Bucaramanga were more likely to attain the TFA goal (compared to Bogota), while those from Medellin were more less likely to meet the dietary fiber goal. Despite the reported lower intake of most nutrients by participants with diabetes, diabetes status only had a significant independent association with meeting the goal for dietary protein (OR 2.00, 95%CI 1.25-3.20).

DISCUSSION

We performed a population-based study to describe diabetes prevalence and associated dietary nutrient ingestion patterns in five Colombian cities representing the main regions of the country. We found an overall prevalence of 10.1% based on self-reported diabetes and random plasma glucose measurements. Diabetes was more common with older age, higher SEL, excess body weight, abdominal obesity, and among residents of Medellin. The association between diabetes prevalence and education was dependent on sex: A higher educational level was associated with a lower prevalence of diabetes among women and with a higher prevalence of diabetes among men. People with diabetes reported significantly less caloric intake than those without diabetes, a difference was also present for most macronutrients, but retained statistical significance after adjustment only in the case of dietary sodium. When compared with current guidelines, the proportion of individuals with diabetes not achieving dietary recommendations for SFA, MUFA, trans fats, fiber and sodium among individuals with diabetes was remarkably high. We also found that the Odds of achieving dietary recommendations were largely influenced different by sex, age group, city of residence and, in the case of dietary protein, diabetes status.

The reported prevalence of diabetes in Colombia varies widely across different studies and official documents, reflecting a lack of accurate population-level data, a problem common to many developing countries. The International Diabetes Federation Diabetes Atlas 2019 estimated an adjusted diabetes prevalence of 7.4% for the Colombian population (34), and the World Health Organization in its 2016 Diabetes Country Profiles reported a total prevalence of 8.0% (12). Meanwhile, the above-mentioned PURE study reported a prevalence of 11.1% for the population aged 35 to 70 from upper-middle income countries (13), much higher than the national survey done by Colombian government in 2007 (35), which found a 3.5% prevalence of self-reported diabetes in adults aged 18 to 69 (36). Results from regional studies are similarly heterogeneous. The CARMELA Study, a population-based study in large Latin American cities, found a diabetes prevalence of 8.1% in Bogotá in 2006 (37), similar to the 8.9% found in the Colombian Caribbean city of Cartagena in 2005 (38). A comparison of our findings with prior studies reveals that the diabetes epidemic seems to be progressing faster in smaller cities in Latin America. For example, diabetes prevalence in a 2006 study of adults in Bucaramanga was only 4%, while we found 7.4%

in the same city (39). We found a comparable diabetes prevalence for most of the cities except for Medellin, where we found a much larger figure. A population study undertaken in Medellin and its suburbs in 2008-2010 (40) found a prevalence of high plasma glucose (fasting plasma glucose >100 mg/dL or taking antidiabetic medication) of 19.8%, quite comparable to our 20.1% by diabetes self-report or random plasma glucose>200 mg/dL, despite the different definition. Further studies are needed in order to identify potential genetic, demographic or cultural reasons for the high prevalence of hyperglycemia in this region of the country.

Worldwide, the prevalence and societal burden of diabetes have been increasing steadily in recent years. Diabetes has moved from being the tenth most relevant cause of disability-adjusted life years (DALYs) lost in 1990, to being the fourth in 2005, and the third in 2015 (41). The rapid expansion of the diabetes epidemic is being driven mostly by small prevalence increases in largely populated Asian countries (China and India) (42), but also by sustained prevalence increases in developed countries in Europe and North America. According to the IDF Diabetes Atlas 2019, diabetes prevalence among adults in the North America and Caribbean region was estimated at 13.3%, while in Europe it was 8.9% (34). The most recent estimate of the US Centers for Disease Control places diabetes prevalence in the USA at 13.0% (43). Thus, our estimations worryingly place the prevalence of diabetes among urban adults from Colombia at a level close to that of developed countries. Overall, our study led to an estimate of diabetes prevalence much more plausible and coherent with international projections than data from existing national health surveys.

The most important independent correlate of diabetes in our study was increasing age, as has been described for most populations worldwide (41). Our study found an estimated prevalence of diabetes among older adults remarkably close to that encountered in recent surveys from the SABE study (17.5% in SABE Bogotá, executed in 2012 (20); 18.5% in SABE Colombia, executed in 2015 (19) and 20.6% in COPEN, executed in 2018). Thus, recent data support the idea of an accelerated increase in the prevalence of diabetes among older adults in Colombia. For the most part, the relationship between socioeconomic status and diabetes is consistent in high-income countries: a lower position increases risk (44-47). Meanwhile, the magnitude and direction of this association in middle- and low-income countries is conflicting across studies, perhaps due to

imperfect data, to the use of different proxies for SEL, or to the rapid development of demographic and nutritional transitions that affect them in ways different from what takes place in the developed world (48-50). In Colombia, the higher prevalence of *diagnosed* diabetes with higher SEL may be explained at least partially by increased access to medical care and diabetes screening with higher income (51).

Prior studies had found an interaction between sex and educational level, so that more educated women had a lower prevalence of diabetes. A large multi-national study reported increasing odds of diabetes as education increased among men from middle-income countries. For women, the association was flat or slightly negative (52). Other studies of the associations between socioeconomic variables and diabetes have also found a different pattern according to sex (53,54). Studies from Mexico (55) Argentina (56) and Brazil (57) have also documented higher rates of obesity and diabetes among more educated males and less educated females. Many factors could explain these results, but one that may apply to our context is a larger degree of body dissatisfaction among women, that increases with higher education. A study in Bogotá showed that women with higher education were more likely to identify thinner body silhouettes as their preferred ones (58). Our results complement a body of evidence suggesting that education of women may be a tool in the fight against the diabetes epidemic in developing countries.

We were surprised to find a lower self-reported weight-adjusted intake of calories and all macronutrients among persons with diabetes. An optimistic interpretation of this finding would be that it shows good adherence to dietary recommendations. However, such interpretation should be made with caution, as it is known that people with diabetes and obesity frequently underreport their caloric intake (59).

The fact that the lower mean intake of all nutrients but sodium in people with diabetes lost significance after multivariate adjustment, suggests that major sociodemographic factors (older age) and a higher BMI are the true factors explaining a lower reported dietary intake in persons with diabetes. In any event, these differences did not result in increased odds of achieving dietary recommended intakes of key nutrients, as only reaching the %TCI from protein was independently associated with diabetes status.

Despite reporting quantitatively less intake of most nutrients, the relative proportion of macronutrients from each source in participants with diabetes was remarkably similar to that of people without diabetes. This finding also applied to fat subtypes: SFA, MUFA and PUFA represented a comparable share of TCI regardless of diabetes status. This points out that individuals with diabetes (many of whom know already know about of their diabetes status), are not modifying enough their diets to intentionally increase the percent of Calories from MUFA, as well as reducing their intake of SFA and TFA. A survey of patients with type 2 diabetes from general practices in the Netherlands found a 15% mean TCI from SFA at the moment of diagnosis, which had descended to 11.9% by four years after diagnosis (60). This is still far from the recommendation of <7% TCI from SFA. Thus, excessive consumption of SFA by people with diabetes seems to be a ubiquitous problem.

The intake of dietary fiber was equally concerning, in this case because of too little consumption, a problem that was more evident in participants who were younger, male, or lived in Medellin. A meta-analysis of randomized controlled trials concluded that diets with foods rich in fiber up to 42.5 g/day reduced glycated hemoglobin by a mean 0.55% and fasting plasma glucose by 9.9 mg/dL in persons with diabetes (61). Hence, a low consumption of dietary fiber constitutes a lost opportunity for improving the health of persons with diabetes. Dietary TFA are a powerful cardiovascular risk factor, even at intakes as low as 2% of TCI. For this reason, their intake is restricted by most dietary guidelines to less than 1g/day, with special emphasis on populations at high baseline risk for cardiovascular disease, like people with diabetes or older people (61). We found that only one in every five individuals with diabetes was achieving this goal, and the odds of achieving it were significantly lower with younger age or higher SES, probably in relation with a higher consumption of processed, industrialized foods (62). TFA intake is an independent predictor of total and cardiovascular mortality (63), so extreme efforts should be put in place in order to limit their consumption both in the general population and among persons with diabetes.

Our results bring out many areas of potential intervention for nutritional prevention, which are particularly relevant in our context. Nutritional education of people with diabetes in developing countries is an urgent measure with large potential benefits and minimal risks.

Limitations of our study include the entirely urban sample, given the recent increase in obesity in rural areas in the continent (64) and Colombia (65). It is important, however, that the proportion of total population living in urban centers is in Colombia is 77.1% (66), a result of accelerated urbanization induced by years of internal conflict that has impacted the epidemiologic profile of the country (14). Another relevant limitation was the unavailability of oral glucose tolerance test (OGTT) data, so our ascertainment of diabetes status relied on random plasma glucose measurement and diabetes self-report, which may lead to underestimation of the true disease prevalence. OGTT is the most sensitive test for diabetes diagnosis but performing it would have imposed great complexities on the logistics of the study. We acknowledge that the prevalences we report, high as they seem, are most likely an underestimation. The use of FFQs for dietary intake assessment has advantages and disadvantages, as FFQs inquire about usual (rather than recent) intake and can be quite comprehensive, but tend to overestimate total caloric intake and to be less accurate than 24-hour diet recalls in the short-term. Finally, our study did not collect detailed information on lifestyle variables like smoking or physical activity, which may explain or correlate with the described dietary intakes.

In summary, our results confirm a continued progression of the diabetes epidemic in middle-income countries, and its relationship with demographic and socioeconomic factors. We also found remarkably low rates of achievement of key nutritional goals among individuals with diabetes, and identified factors associated with their achievement. Further research focused in rural areas is needed in order to build a complete the picture of evolution of the diabetes epidemic in the developing world.

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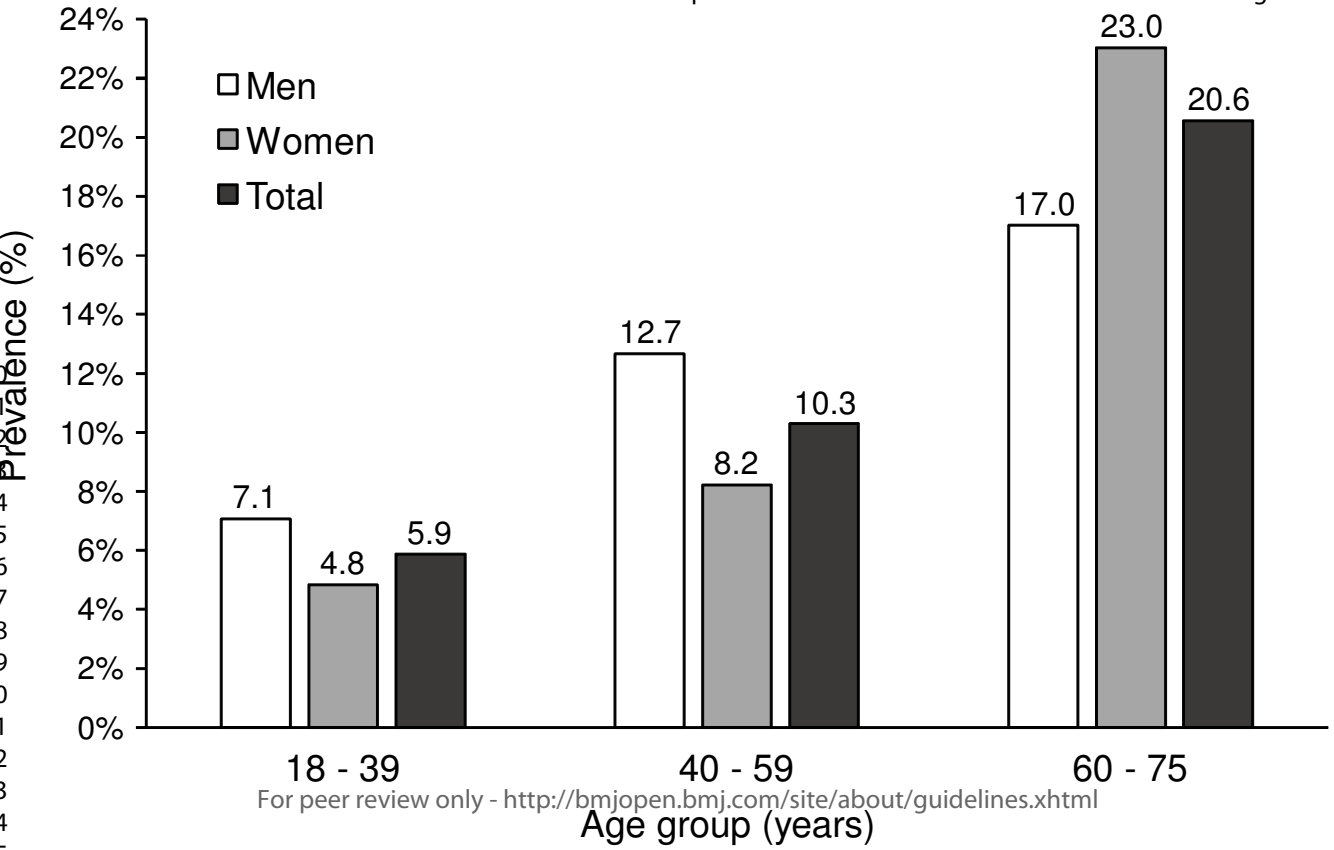
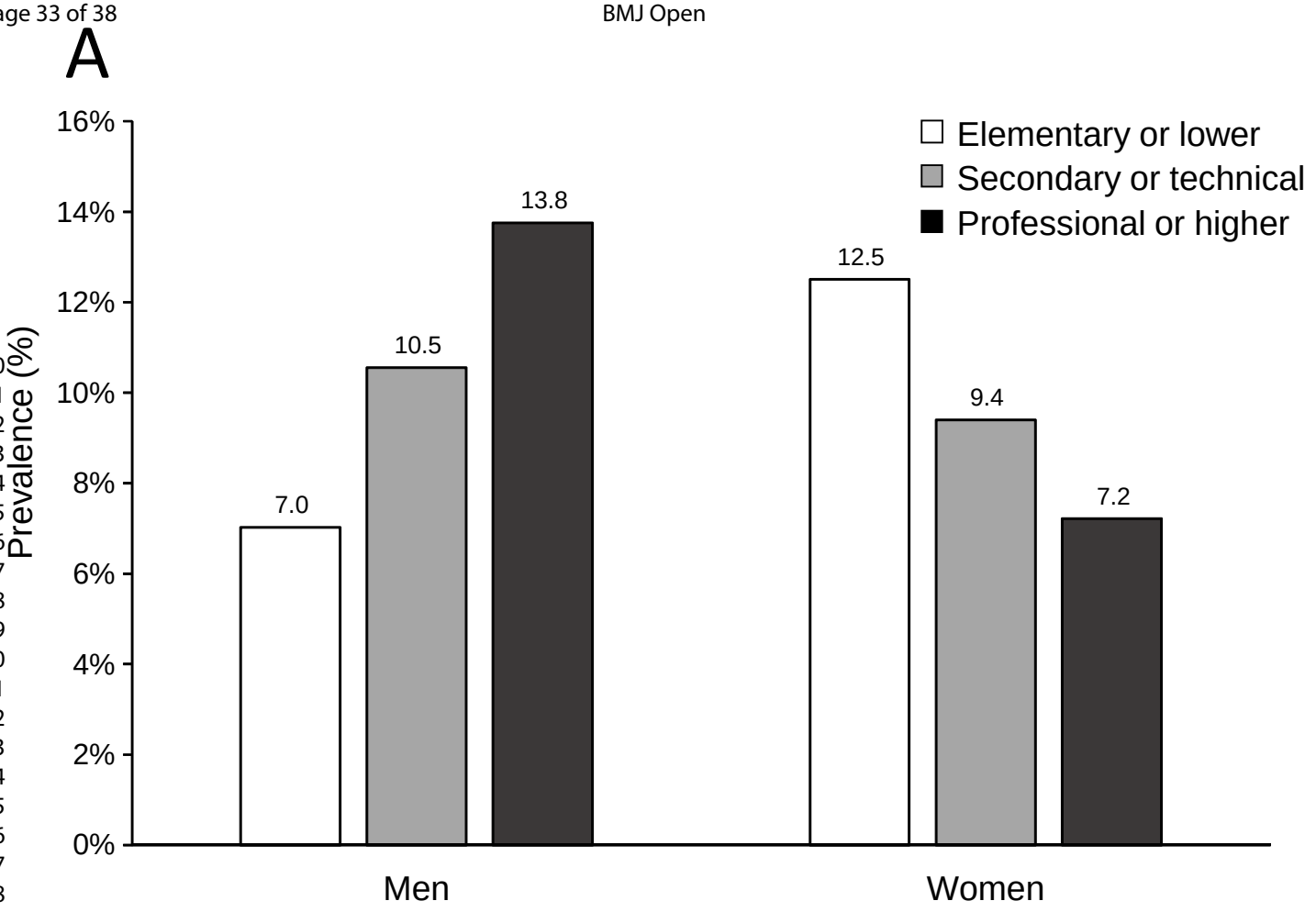
Figure legends

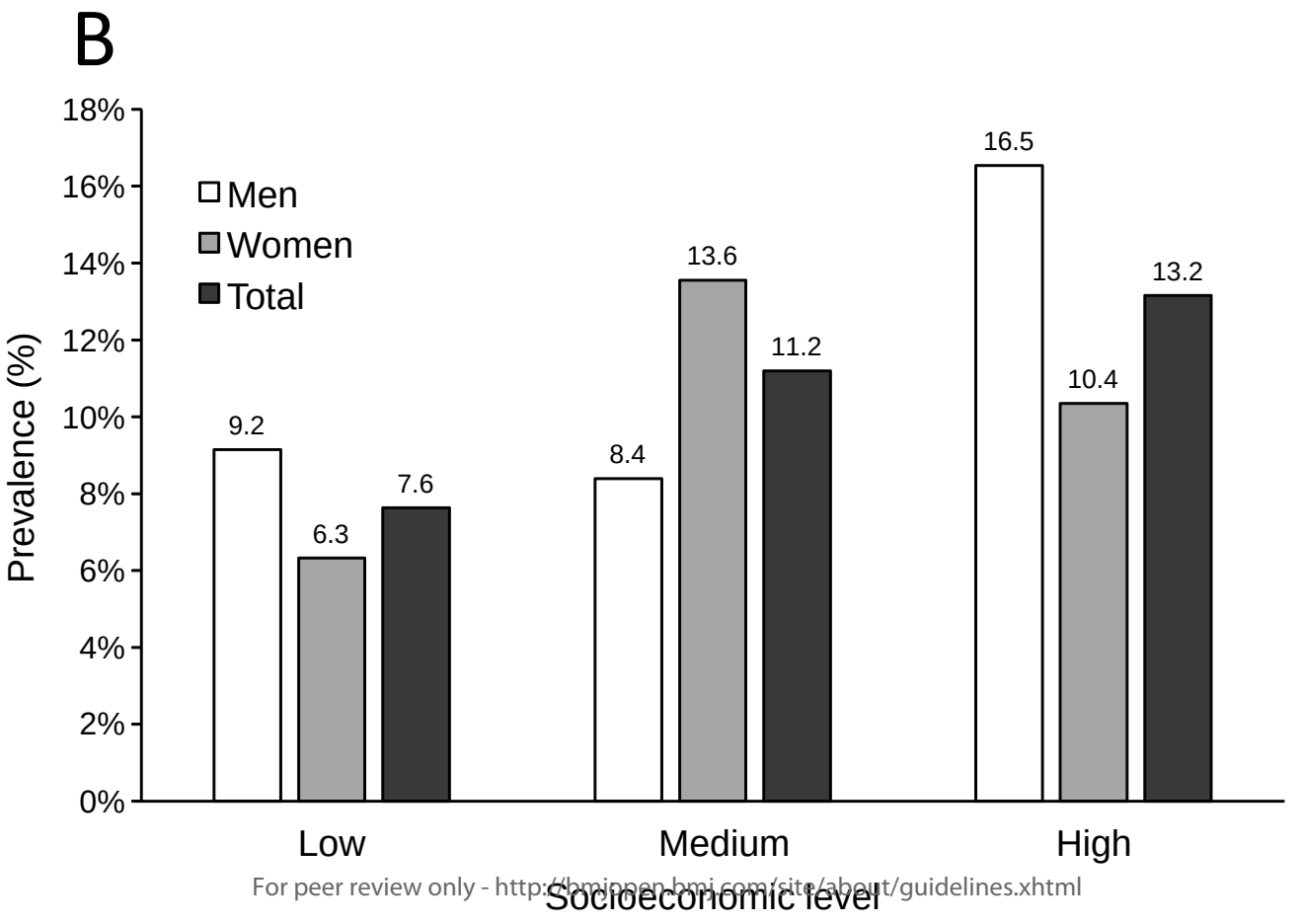
Figure 1. Prevalence of diabetes, by age and sex. Data are prevalences using sampling weights. P-value for the overall difference in prevalence among age groups <0.001. P-value for the trend in diabetes prevalence with increasing age group <0.001.

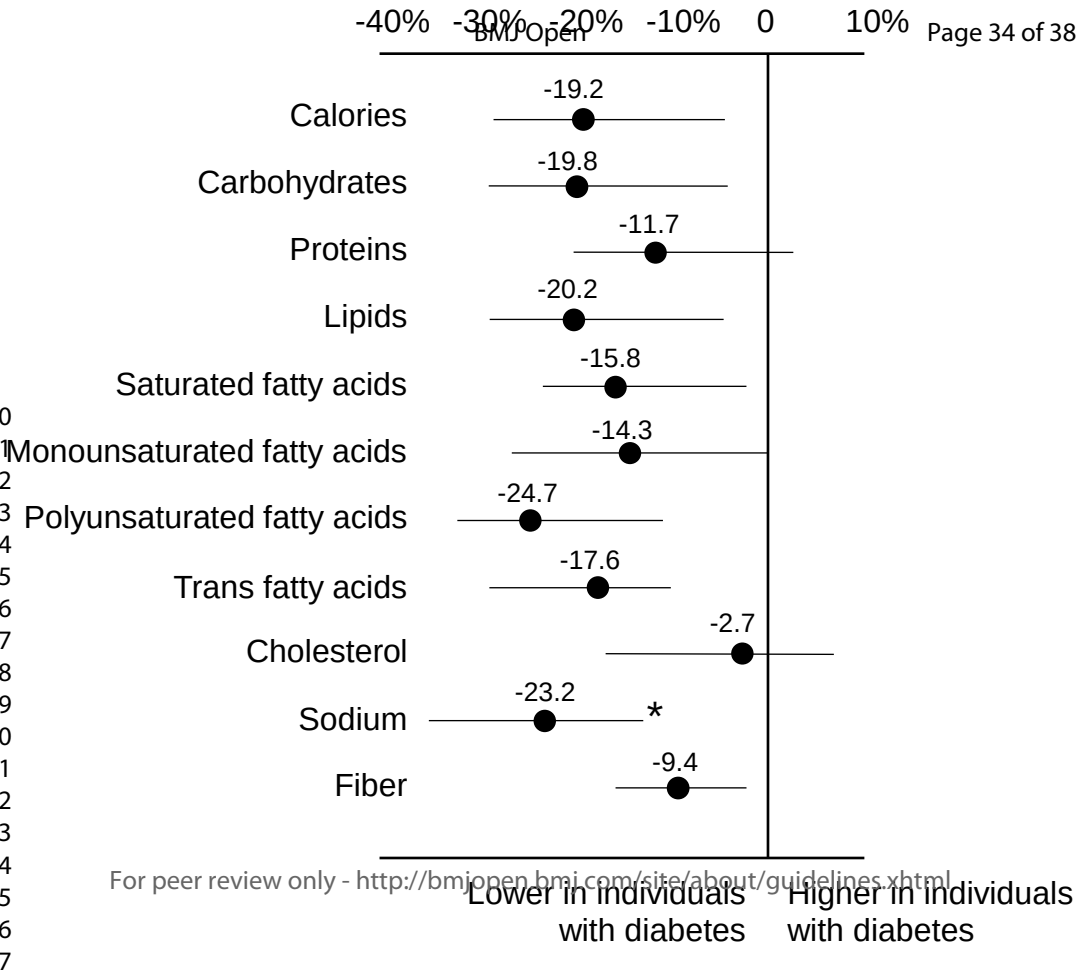
Figure 2. Prevalence of diabetes, by educational level (Panel A) and socioeconomic level (Panel B), and sex. Educational level refers to the highest level completed. Socioeconomic level (SEL) was classified according to Colombia´s official Statistics Department-DANE stratification scheme. Low SEL includes strata 1 and 2, medium SEL includes only stratum 3, and high SEL includes strata 4, 5 and 6. Data are prevalences using sampling weights. P-value for the overall difference in diabetes prevalence among socioeconomic levels=0.11. P-value for the trend in diabetes prevalence with increasing socioeconomic level=0.04.

Figure 3. Difference in age, sex, BMI and SEL-adjusted nutrient intake (in g/d), between individuals with diabetes and individuals without diabetes. Dots represent medians and lines represent Q1-Q4. *p=0.013 for the adjusted comparison versus individuals without diabetes.





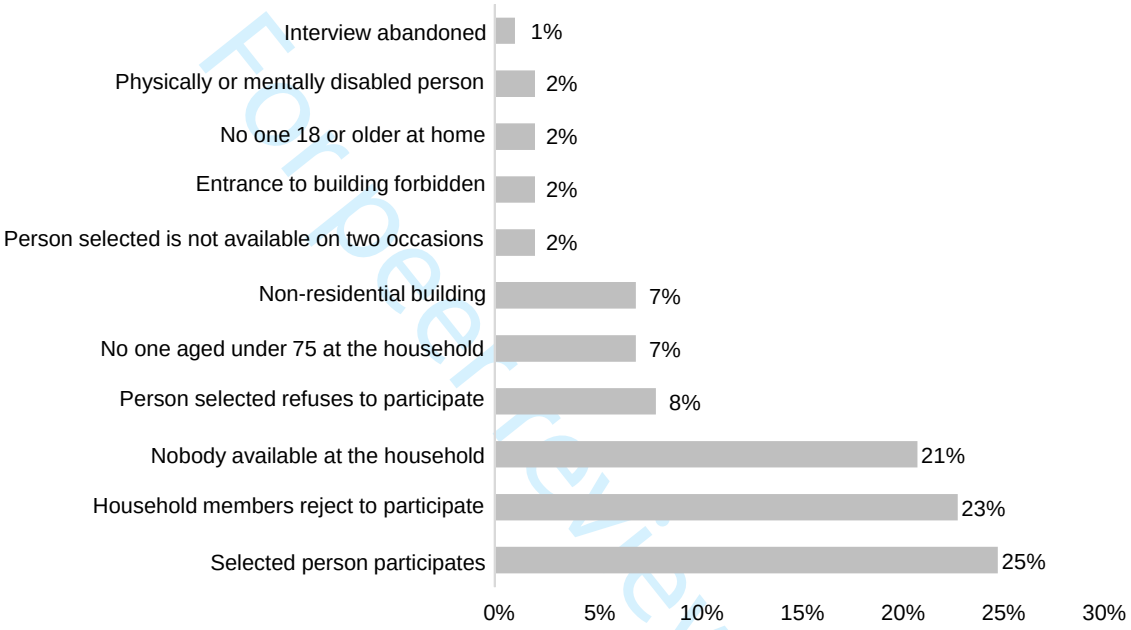




Dietary intake among urban adults with diabetes: COPEN (Colombian Nutritional Profiles), a cross-sectional study

Supplementary Material

Supplemental Figure 1. Results of 7640 contacts for recruitment of study participants.

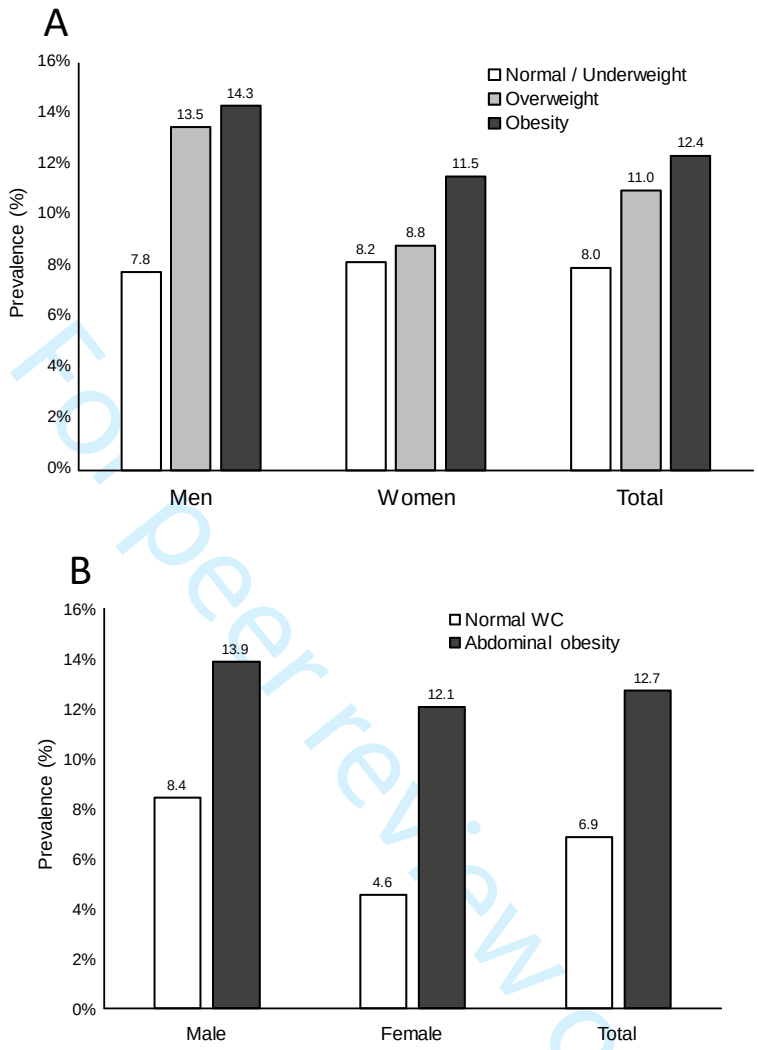


Supplemental table 1. Daily intake of macronutrients, cholesterol, sodium and fiber, by diabetes diagnosis. SFA: Saturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA: Polyunsaturated fatty acids. Data are means using sampling weights+/- SD.

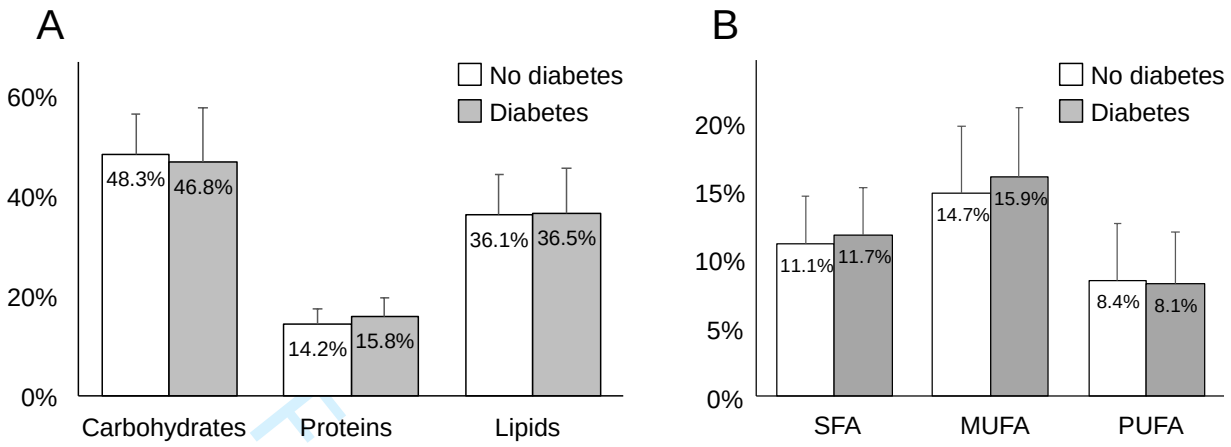
	Diabetes diagnosis			Univariate p-value
	No	Yes	Difference	
Calories (Cal/Kg/day)	58.5 +/- 31.2	44.1 +/- 22.4	-14.4	<0.001
Carbohydrates (g/Kg/day)	7.08 +/- 3.9	5.18 +/- 3.1	-1.90	0.002
Protein (g/Kg/day)	2.03 +/- 1.2	1.72 +/- 0.8	-0.31	0.076
Lipids (g/Kg/day)	2.35 +/- 1.4	1.79 +/- 1	-0.56	<0.001
SFA (g/Kg/day)	0.73 +/- 0.5	0.58 +/- 0.4	-0.14	0.017
MUFA (g/Kg/day)	0.96 +/- 0.6	0.79 +/- 0.4	-0.17	0.01
PUFA (g/Kg/day)	0.56 +/- 0.4	0.39 +/- 0.3	-0.17	<0.001
Trans fatty acids (mg/day)	2.4 +/- 1.8	2.0 +/- 1.2	-0.41	0.005
Cholesterol (mg/day)	702.5 +/- 494.3	647.8 +/- 442.1	-54.7	0.75
Sodium (mg/day)	5330 +/- 2767	3840 +/- 1913.2	-1490	<0.001
Fiber (g/day)	37.9 +/- 16.9	33.2 +/- 14.1	-4.72	0.077

Supplemental Table 2. Predictors of achievement of different dietary recommendations (goals) in multivariate, mutually adjusted logistic regression models. Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model 3 had all variables in model 2 plus BMI, model 4 had all variables in model 3 plus city, and model 5 had all variables in model 4 plus diabetes status. For SEL, the reference category was low SEL, for BMI the reference category was normal or underweight (<25 Kg/m^2), for city the reference category was Bogota. In model 5 for all goals, the OR for diabetes status and its corresponding 95% confidence interval are presented.

Goal	Model 1	Model 2	Model 3	Model 4	Model 5
Trans fat <1g/day	Age (per year): OR 1.015 (1.004-1.026)	Age (per year): OR 1.017 (1.006-1.028) Medium SEL: OR 0.62 (0.39-0.98) High SEL: OR 0.66 (0.42-1.04)	Age (per year): OR 1.016 (1.006-1.028) Medium SEL: OR 0.61 (0.39-0.98)	Age (per year): OR 1.019 (1.007-1.031) Medium SEL: OR 0.61 (0.38-0.97) Cali: OR 2.12 (1.25-3.61) Bucaramanga: OR 2.47 (1.35-4.52)	Age (per year): OR 1.019 (1.007-1.031) Medium SEL: OR 0.61 (0.38-0.97) Cali: OR 2.12 (1.24-3.62) Bucaramanga: OR 2.47 (1.35-4.52) **Diabetes: OR 1.05 (0.58-1.89)**
Sodium <2300 mg/day	Male sex: OR 0.45 (0.25-0.79) Age (per year): OR 1.024 (1.008-1.040)	Male sex: OR 0.44 (0.25-0.78) Age (per year): OR 1.024 (1.008-1.040)	Male sex: OR 0.46 (0.26-0.82) Age (per year): OR 1.026 (1.009-1.044)	Male sex: OR 0.46 (0.26-0.83) Age (per year): OR 1.028 (1.010-1.046)	Male sex OR 0.46 (0.25-0.82) Age (per year): OR 1.026 (1.008-1.044) **Diabetes: OR 1.50 (0.73-3.08)**
Protein >=15% of TCI	No significant predictors	Medium SEL: OR 0.78 (0.39-0.98) High SEL: OR 1.93 (1.35-2.77)	High SEL: OR 2.05 (1.41-2.96) Obesity: OR 1.95 (1.30-2.92)	High SEL: OR 2.08 (1.43-3.02) Obesity: OR 2.02 (1.33-3.06)	High SEL: OR 2.01 (1.38-2.93) Obesity: OR 2.02 (1.33-3.06) **Diabetes: OR 2.03 (1.26-3.26)**
SFA <10% of TCI	No significant predictors	Age (per year): OR 1.017 (1.000-1.033) Medium SEL: OR 0.78 (0.39-0.98) High SEL: OR 0.16 (0.06-0.42)	High SEL: OR 0.16 (0.06-0.42) Overweight: OR 2.15 (1.11-4.17)	High SEL: OR 0.16 (0.06-0.41) Overweight: OR 2.02 (1.04-3.94)	High SEL: OR 0.16 (0.06-0.42) Overweight: OR 2.00 (1.03-3.91) **Diabetes: OR 0.55 (0.19-1.64)**
MUFA >=12% of TCI	Male sex: OR 0.64 (0.45-0.92)	Male sex: OR 0.63 (0.44-0.90) High SEL: OR 2.34 (1.47-3.72)	Male sex: OR 0.62 (0.43-0.89) High SEL: OR 2.27 (1.42-3.62)	Male sex: OR 0.61 (0.42-0.88) High SEL: OR 2.38 (1.48-3.83) Bucaramanga: OR 0.46 (0.26-0.83)	Male sex: OR 0.60 (0.41-0.87) High SEL: OR 2.32 (1.44-3.74) Bucaramanga: OR 0.47 (0.26-0.84) **Diabetes: OR 1.70 (0.91-3.19)**
Fiber >=14g/ 1,000 Cal	Male sex: OR 0.61 (0.37-0.99) Age (per year): OR 1.035 (1.019-1.050)	Male sex: OR 0.61 (0.37-0.99) Age (per year): OR 1.034 (1.019-1.050)	Male sex: OR 0.58 (0.35-0.95) Age (per year): OR 1.034 (1.018-1.050)	Male sex: OR 0.58 (0.35-0.97) Age (per year): OR 1.037 (1.021-1.054) Medellin: OR 0.21 (0.08-0.52)	Male sex: OR 0.58 (0.35-0.96) Age (per year): OR 1.036 (1.019-1.053) Medellin: OR 0.21 (0.08-0.51) **Diabetes: OR 1.31 (0.67-2.56)**



Supplemental Figure 2. Prevalence of diabetes, by body-mass index (Panel A) and waist circumference (Panel B) status. Underweight was defined as a body mass index (BMI) of less than 18.5 Kg/m^2, normal weight as a BMI between 18.5 and less than 25 Kg/m^2, overweight as a BMI between 25 and less than 30 Kg/m^2, and obesity as a BMI of 30 or higher. Abdominal obesity was defined as a waist circumference of 90 cm or higher in women, and 94 cm or higher in men. Data are prevalences using sampling weights.



Supplemental Figure 3. Distribution of total caloric intake (TCI) from each macronutrient (Panel A) and percent TCI from each fat type (Panel B) according to diabetes status. SFA: Saturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA: Polyunsaturated fatty acids. $p<0.001$ for the difference in percent TCI from protein, and $p=0.031$ for the difference in percent TCI from MUFA.

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Diabetes and associated dietary intake among urban adults: COPEN (Colombian Nutritional Profiles), a cross-sectional study

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Diabetes and associated dietary intake among urban adults: COPEN (Colombian Nutritional Profiles), a cross-sectional study

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ABSTRACT

Objectives: Diabetes is increasing rapidly in developing countries. We aimed to estimate the prevalence of diabetes, describe its correlates and its associated dietary intake in urban adults from Colombia.

Setting: The Colombian Study of Nutritional Profiles (COPEN) was a population-based, cross-sectional, multi-stage probabilistic sampling survey designed to represent the five main Colombian cities.

Participants: Between June and November 2018, we studied 736 non-pregnant participants aged 18 or older. Diabetes was defined as a random plasma glucose >= 200 mg/dL, self-reported prior diagnosis of diabetes or use of any oral or injectable antidiabetic medication(s). Participants also fulfilled a detailed 157-item food frequency questionnaire (FFQ).

Primary and secondary outcome measures: Prevalence of diabetes, dietary intake of key nutrients, achievement of dietary goals among individuals with diabetes.

Results: The overall estimated prevalence of diabetes was 10.1%, with no difference by sex (9.6% in women, 10.8% in men, p=0.43). The association between diabetes and education level depended on sex, diabetes was more prevalent among more educated men and less educated women. Abdominal obesity was associated with a 65% increase in diabetes prevalence among men, and a 163% increase in women. Individuals with diabetes reported lower mean consumption of all nutrients, but after adjustment by sex, age, socioeconomic level and body-mass index, only their lower sodium consumption remained significant (p=0.013). The proportion of non-achievement of dietary intake goals among participants with diabetes was 94.4% for saturated fats, 86.7% for sodium, 84.4% for fiber and 80% for trans fats. In multivariate logistic regression models, age was the strongest independent correlate of diabetes.

Conclusions

Self-reported diabetes was highly prevalent among Colombian adults, much more than described in most official reports. There were large differences by abdominal obesity status, region of

residence, SEL and educational level. The proportion of individuals with diabetes meeting dietary recommendations was alarmingly low.

Strengths and limitations of this study

- The study explored the prevalence of diabetes and its associated dietary nutrient intake, as well as their relationship to key demographic factors.

- The study had a population-based, probabilistic sample from five cities in Colombia.

- Dietary intake was assessed with a food frequency questionnaire adapted to national and regional dietary habits, and inquiring about usual behavior, rather than recent intake.

- Random plasma glucose and self-reported diabetes may underestimate the real diabetes prevalence compared to oral glucose tolerance tests or glycated hemoglobin measurement.

- Our study did not include any participants from rural areas, whose diabetes prevalence and associated diet may differ significantly from those of urban populations.

Data sharing statement

The study dataset and its associated variable definitions file have been publicly deposited in the dryad repository, they can be consulted under the following link: https://doi.org/10.5061/dryad.sqv9s4n2n

INTRODUCTION

The number of deaths attributed to diabetes in the year 2010 was 3.96 million, on average every eight seconds one person died from diabetes somewhere in the world (1). It is estimated that, if current trends persist, 700 million adults will live with diabetes by 2045 (2). As life expectancy increases, the number of older adults with diabetes will rise from 136 million to 276 million (2).

In South and Central America, the age-adjusted prevalence of diabetes has been estimated at 8.5% in 2019 and is expected to advance to 9.9% by 2045 (2,3). Brazil and Mexico, the most populated countries in the region, occupy respectively the fifth and sixth position in the ranking of countries with the most people with diabetes worldwide (2). The prevalence of diabetes varies widely across Latin American countries. Current data show that Puerto Rico and Mexico are the countries with the highest prevalence in the region (13.7% and 13.5% respectively), while Ecuador (5.5%) and Argentina (5.9%) have the lowest (1, 4-8). Latin America is the region where diabetes represents the largest proportion of total health expenditure (around 20% of total) (2). The cost of diabetes in Latin America and the Caribbean in 2015 was estimated at 103-142 billion dollars, a 6 to 7-fold increase relative to 2000 (9). Rapid urbanization and aging are the two main drivers of the diabetes epidemic in Latin America (10).

It is expected that, over the coming decades, the largest increase in people with diabetes will occur in countries experimenting the low to middle-income transition (1,11, 12). The Prospective Urban and Rural Epidemiology (PURE) study found that lower-income countries had the highest age and sex-adjusted prevalence of diabetes (average 12.3%), followed by upper-middle (average 11.1%,), lower-middle (average 8.7%) and high income countries (average 6.6%) (13).

Colombia is a South American country of about 48 million inhabitants, in which no recent population-based studies exploring the prevalence of diabetes or the comparative characteristics of dietary intake among individuals with diabetes are available. In Colombia, the urbanization phenomenon has been further complicated by the internal displacement of hundreds of thousands of citizens as a result a protracted internal conflict that only came to an end in the recent years (14). The estimated cost of diabetes in Colombia is the fourth largest in the region below Brazil,

Mexico and Venezuela (9). The official sources of information about the burden of diabetes in Colombia are not population-based studies, but claim databases like the High-Cost Account (*Cuenta de Alto Costo* - CAC) (15), a registry kept by an association of Colombian health insurance companies. Another frequently cited source is SISPRO (*Sistema Integrado de Información de Protección Social* - Integrated Social Protection Information System) (www.sispro.gov.co), a database that compiles all health services and procedures provided by the Colombian health system (16). These sources are useful for planning the provision of health services, but they cannot provide estimations of diabetes and its associated factors at the population level. For instance, the CAC reported a diabetes prevalence of 2.2% between July 2016 and June 2017, a figure far removed from all worldwide data in similar countries and from IDF projections (2,5,17,18). Similarly, these official sources based on care provision do not register relevant lifestyle variables, so they do not allow the exploration of dietary habits of people with diabetes in the general population. There are, however, some sources of estimates for the population prevalence of diabetes, but they are confined to a specific population group. Thus, the SABE (from the Spanish SAlud, Bienestar y Envejecimiento – Health, well-being and ageing) Colombia study found a rate of self-reported diabetes of 18.5% among adults aged over the age of 60 in 2015 (19). A similar prevalence (17.5%) was found in the SABE Bogotá survey of older adults in the country´s capital (20).

In Colombia, population-based surveys have demonstrated a notorious increase in both child and adult obesity over the last two decades (21). Such increases parallel those observed in Mexico and other Latin-American countries, suggesting that the recent phenomena of mass urbanization, westernization of dietary habits and adoption of sedentary behaviors are translating into a demographic and nutrition transition in the whole region (22). These changes have disproportionately affected more economically vulnerable segments of the population (23).

In addition to the recent rise in obesity, Colombia has also experienced a slow but sustained increase in life expectancy that started in the second half of the 20th century, especially among women (24). The combination of these factors greatly favors the development of diabetes and other chronic diseases, hence the exploration of the current of diabetes and its associated dietary behaviors is of great importance.

Dietary behavior is a crucial determinant of the degree of control and the development of chronic complications among individuals with diabetes. Dietary habits have a large impact on various parameters directly related to the risk of chronic complications, among them blood glucose levels, plasma lipids and blood pressure (25). Hence, the adequate documentation and exploration of the dietary habits of this population is of the utmost importance to guide clinical strategies and public health policies aimed at persons with diabetes. Despite the multiple combinations of macronutrients that may be adjusted to each person´s requirements and cultural preferences, most guidelines agree on a few universal goals whose attainment predicts a larger probability of diabetes control, and prevention of chronic complications (26). These goals usually comprise the distribution of calories among the different macronutrients, the restriction of dietary trans fats, sodium and cholesterol, and the provision of an adequate amount of dietary fiber. We expected that most persons with diabetes would attain these dietary goals in Colombian cities. Also, given the known association of diabetes with excess body weight and hence a net positive caloric balance, we expected caloric and nutrient intake to be higher among individuals with diabetes.

Colombia is a geographically, racially and culturally diverse country with marked differences among the five most populated regions: i. Central plateau (administrative and economic center of the country), ii. Caribbean region, with culture and costumes similar to those of Caribbean nations, iii. Pacific coast, a very industrialized region but also with high indexes of poverty and where most of the Afro-Colombian population resides, iv. Northwestern or “paisa” region, where there are many local traditions and there is a larger degree of European and Jewish ancestry and v. Northeastern/Andean region, mostly cold, very mountainous and with a larger degree of indigenous ancestry. Given that 81% of the Colombian population lives currently in urban centers, we undertook a study in five cities, one from each region, in order to answer the following research question: What is the prevalence of diabetes by self-report or random plasma glucose in the main urban centers of Colombia, and how does the nutrient intake of these individuals compare to that of people without diabetes? An ancillary goal of the study was to explore to what extent do people with diabetes achieve the internationally recommended dietary goals for individuals with diabetes.

Given the recent rise in obesity rates, rapid urbanization and increased life expectancy, we expected to find a diabetes prevalence greater than that estimated from prior national surveys, but still lower than that of the largest Latin American countries Brazil and Mexico.

METHODS

COPEN (Estudio Colombiano de Perfiles Nutricionales – Colombian Study of Nutritional Profiles) was a population-based, cross-sectional, multi-stage sampling survey designed to represent five cities, one from each of Colombia´s major regions: Bogotá (Central plateau), Barranquilla (Caribbean region), Cali (Pacific region), Medellin (Northwest or "paisa" region) and Bucaramanga (Northeast/Andean region). The sampling frame was obtained from the last census of the Colombian population, cartography was obtained from the national geostatistical frame developed by the Colombian National Department of Statistics (Departamento Administrativo Nacional de Estadística - DANE) and data on socioeconomic level (SEL) came from the National Superintendence of Public Services. In the first stage of sampling we selected cartographic sectors, within sectors we selected blocks (on average 8 per cartographic sector), within blocks we selected households, and within households we selected individual participants. Within each household, individuals were randomly selected employing a Kish grid. The sample was stratified by city, sex, age group and SEL. With this design and including the design effect, the complete study sample yielded an overall sampling error of 2.2%. The sampling errors for each city were respectively: Bogotá 4.0%, Medellin 5.0%, Cali 5.0%, Barranquilla 5.6% and Bucaramanga 6.8%. We excluded foreigners living in Colombia, individuals in hemodialysis or peritoneal dialysis therapy and persons with disabilities that precluded a reliable fulfillment of the study questionnaire. The complete study for COPEN was 1942 individuals, from which a random subsample of 736 non-pregnant participants aged 18 or older (representing 47.8% of all non-pregnant adults in COPEN) participated in the analyses reported in this paper. This was mainly due to cost constrains that did not allow us to perform blood tests in all 1942 COPEN participants. We selected individuals living in the household, regardless of whether they were family members or working at the household. We performed at least two attempts to interview the selected adult. If the individual selected was still not present or declined to participate, he/she was replaced by someone from the same sampling stratum in a different household.

Information was captured using a tablet device containing digital forms with proper validation rules, developed for the study. All staff in charge of data collection was extensively trained by the study Principal Investigator. A random 10% of participants were re-contacted by phone in order

to double-check the accuracy of the information provided on date of birth, sex, city of residence, marital status, job status, educational level and date of initial contact. We confirmed data on date of birth, sex, city of residence, SES, marital status job status, educational level and date of initial contact. In all variables, we had over 95% concordance with the values originally reported. All data were collected between June and November 2018. Supplemental Figure 1 summarizes the scheme of participant recruitment for the study.

Patient and Public Involvement

Patients and the public were not involved in the design of the study, but aggregated results will be presented to local and national authorities to inform public health policies concerning nutrition and primary prevention of diabetes.

Measurements

We collected information on sex, date of birth, SEL, marital status, educational level and employment status using a standardized questionnaire. Since diabetes incidence rises sharply at age 40 and peaks approximately at age 60 (27), age was operationalized for most analyses in three groups: 18-39, 40-59 and 60-75 years. The SEL that we employed for analyses was the one registered in DANE for that particular block. After a brief introduction about the importance of the accuracy of the measurements to be performed, we measured height and weight in all participants, and waist circumference in participants aged 18 and older. Height was measured using a portable stadiometer supported on a firm surface, taking care that the participant was barefoot, standing right and with heels and calves touching the stadiometer. Weight was measured in a solar digital scale with 100g sensitivity and 200 Kg capacity, all study scales were calibrated simultaneously the day before the study start, and every week afterwards. Waist circumference was measured by a sitting observer, directly over the participant´s skin, at the midpoint between the las rib and the anterosuperior iliac crest, using a flexible metallic measuring tape. All measurements were performed in duplicate, and if there was a between-measures discrepancy greater than 1 cm for height, 100g for weight or 1 cm for waist circumference, a third measurement was collected. For analyses we used the average of each anthropometric measure.

Socioeconomic level is classified in Colombia by the Statistics Department DANE in 6 strata according to characteristics of the residence (with stratum 1 being the lowest and stratum 6 being the highest) (28). Residential dwellings are classified according to their physical characteristics and environment. The methodology for this classification creates homogeneous strata taking as input information about land use, public utilities, access routes, topography, land valuation and property characteristics. The stratification unit is the sub-zone, corresponding generally to a block. Residential dwellings are classified in the predominant stratum of the sub-zone, as long as their characteristics do not differ ostensibly from the predominant conditions in the group. Otherwise, they are considered outliers and their stratum is assessed based on their particular characteristics. This information is very well established, updated and freely accessible for all the country. Given that sociodemographic, income and human development indicators are more similar for individuals living in strata 4 to 6 than among the other strata (28), we analyzed SEL in three groups, corresponding to strata 1-2 (low SEL), 3 (medium SEL) and 4-6 (high SEL). Marital status was classified in three categories: i. Single, ii. Married or in cohabitation and iii. Widowed or divorced. Educational level was analyzed as the highest completed level in three categories: i. Elementary or lower, ii. Secondary or technical and iii. Professional or higher. We interpreted BMI according to the cut points proposed by the World Health Organization (WHO): Underweight (BMI<18.5 Kg/m2), normal weight (BMI >=18.5 and <25 Kg/m2), overweight (BMI>=25 and <30 Kg/m2) and obesity (BMI>=30 Kg/m2). We defined abdominal obesity as a waist circumference >= 90cm for women, and >= 94cm for men, according to the proposed cutoffs for Latin American adults (29).

Capillary blood specimens were collected by trained staff following standardized procedures, blood glucose levels were promptly measured and registered using an Accu-Check meter. Since fasting could not be guaranteed, we considered that an individual had diabetes if he/she met one of these three conditions: 1. A capillary blood glucose level >= 200 mg/dL, 2. A self-reported prior diagnosis of diabetes or 3. Self-reported use of any oral or injectable antidiabetic medication (s) (30).

Usual dietary intake was assessed employing a 157-item semi-quantitative food-frequency questionnaire (FFQ). The FFQ was an enhanced and adapted version of an earlier FFQ specifically

designed for the Colombian population (31). In a prior validation against four independent 24-hour dietary recalls, a shorter version of the FFQ showed a percent of classification in the same quartile of nutrient intake between 61 and 83%, and Pearson correlation coefficients between 0.51 for protein and 0.77 for carbohydrate (32). Portion sizes were established according to the reference unit most frequently consumed for each food. There were 9 possible ingestion frequencies: i. Never, ii. One to three times/month, iii. At least once/week, iv. Two to four times/week, v. Five to six times/week; vi. Once a day, vii. Two to three times a day, viii. Four to five times a day and ix. Six or more times a day. Participants were asked to make their selections based on their usual intake over the last year. FFQs were individually administered by study staff. The nutrient contribution of each food was calculated according to composition tables by the Colombian Institute for Family Welfare (Instituto Colombiano de Bienestar Familiar - ICBF), the United States Department of Agriculture and manufacturer´s information. We only had very general data on physical activity from the iPAQ (International Physical Activity Questionnaire), short form. This instrument has 7 questions on the frequency and duration of light, moderate or intense physical activity and approximate number of sitting hours (sedentary behavior), but we considered that the degree of detail in the variable did not allow for its use as a covariate for adjustment in our analyses. The COPEN protocol and COPEN field materials (in Spanish) are provided as Supplementary Material 1 and 2, respectively.

Data analysis

Prevalence of diabetes was estimated using sampling weights reflecting city, sex, age group and SEL-specific expansion factors according to the study multi-stage sampling design. We did not have any missing data points for sociodemographic factors, diabetes status and dietary intake variables. The overall diabetes prevalence, as well as the prevalence for men and women were age-adjusted using the WHO standard population as reference population (33). The univariate associations between nominal predictors and diabetes status were examined using chi-square independence tests. To test for a linear trend in the association between ordinal predictors and diabetes status, we report the p-value associated with a rank-correlation (Spearman) test between predictor and outcome. We also ran multivariable logistic models in which sex, age group, SEL and educational level were the independent variables and diabetes status was the outcome. We initially compared mean consumption of macronutrients and micronutrients of interest between

individuals with or without diabetes using a one-way ANOVA, with diabetes as fixed factor. Since a higher BMI is associated with diabetes risk and also with a higher dietary nutrient intake, we also performed multivariable linear regression analyses in which age, sex, BMI, SEL and diabetes status were the predictors and the daily consumption of each nutrient was the dependent variable (one model per nutrient). We explored the achievement of dietary recommendations among individuals with diabetes, expressed as the percent of individuals with diabetes who met the protein (>=15% of total caloric intake [TCI]), saturated fat (SFA) (<7% of TCI), monounsaturated fat (MUFA) (>=12% of TCI) and trans fat (<1g/day) recommendations set by the by the Latin-American Diabetes Association (30) and the fiber (14 g per each 1,000 Calories) and sodium (<2300 mg/day) goals set by the American Diabetes Association (34). In order to explore factors associated with achievement of dietary goals, we also built a series of nested multivariable logistic models, in which achievement of each dietary goal was the outcome. Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model 3 had all variables in model 2 plus city, model 4 had all variables in model 3 plus BMI, and model 5 had all variables in model 4 plus diabetes status. All analyses were performed in SPSS for Windows, v.21 (Cary, NC, USA).

Ethical aspects

All participants provided written informed consent. All study procedures were performed according to the principles of the Helsinki Declaration, and to local rules and regulations as provided by Resolution 8430 of 1993 of the Colombian Ministry of Health. The study was approved by the IRB of Universidad de los Andes (Comité de Ética de la Vicerrectoría de Investigaciones), according to minute 1016 of April 27, 2018.

RESULTS

We studied 736 adults (45% men): 132 from Barranquilla, 250 from Bogotá, 86 from Bucaramanga, 126 from Cali and 142 from Medellin. Mean age was 46.1 +/- 17.6 years, about a third of participants were older than 60. Mean BMI was higher in women than men. There were similar proportions of single and married participants, while widowed or divorced individuals were the minority. There was approximately one third of the sample in each of the low, medium and high SEL categories. Only a fifth of study participants had a college or higher degree, and about a fifth had only elementary or lower education (Table 1).

Table 1. Characteristics of the study sample.

		Men n=331 n (%)	Women n=405 n (%)	Total n=736 n (%)
Age (years)	18-39	129 (39.0)	159 (39.3)	288 (39.1)
	40-59	108 (32.6)	127 (31.4)	235 (31.9)
	60-75	94 (28.4)	119 (29.4)	213 (28.9)
City	Barranquilla	66 (19.9)	66 (16.3)	132 (17.9)
	Bogotá	109 (32.9)	141 (34.8)	250 (34.0)
	Bucaramanga	38 (11.5)	48 (11.9)	86 (11.7)
	Cali	50 (15.1)	76 (18.8)	126 (17.1)
	Medellin	68 (20.5)	74 (18.3)	142 (19.3)
Marital status	Single	151 (45.6)	139 (34.3)	290 (39.4)
	Married/cohabitation	155 (46.8)	200 (49.4)	355 (48.2)
	Widowed/divorced	25 (7.6)	66 (16.3)	91 (12.4)
Educational level	Elementary or lower	66 (19.9)	90 (22.2)	156 (21.2)
	Secondary or technical	191 (57.7)	246 (58.2)	427 (58.0)
	Professional or higher	74 (22.4)	79 (19.5)	153 (20.8)
Socioeconomic level	Low	131 (39.6)	166 (41.0)	297 (40.4)
	Medium	98 (29.6)	121 (29.9)	219 (29.8)
	High	102 (30.8)	118 (29.1)	220 (29.9)
BMI	(mean +/- SD)	25.9 +/- 4.7	28.0 +/- 6,5	27.1 +/- 5,8
Abdominal obesity (n=723)	Yes	166 (51.6)	118 (29.4)	284 (39.3)
	No	156 (48.4)	283 (70.6)	445 (60.7)

Educational level refers to the highest level completed. Socioeconomic level (SEL) according to Colombia´s official Statistics Department-DANE stratification scheme, using criteria about land use, public utilities, access routes, topography, land valuation and property characteristics of the property inhabited by the household. Low SEL includes

strata 1 and 2, medium SEL includes only stratum 3, and high SEL includes strata 4, 5 and 6. Data are n (%) unless indicated otherwise .

Compared to the official population data from Colombia reported to the UN (35), the sex and marital status distribution of urban adults aged 20-75 in Colombia was similar to that of our sample. We had a mild overrepresentation of adults aged 60-75 (28.9 *versus* 14.5% in the general population). Since we only included the five major cities, we believe this may be due to better living conditions and healthcare in large metropolitan areas that cause a greater longevity in large urban centers.

The overall estimated prevalence of diabetes was 10.1% +/- 3.2% (age-adjusted 9.44 +/- 3.0%), with no significant difference between sexes (9.6% +/- 4.3% in women, 10.8% +/- 4.7% in men; p=0.43, age-adjusted 9.5% +/- 4.1% in women, 9.2% +/- 4.0% in men) (Figure 1). The prevalence was highest in Medellin (20.5% +/- 7.2%), followed by Cali (9.2% +/- 7.5%), Bogotá (8.1% +/- 5.3%), Barranquilla (8.0% +/- 7.9%) and Bucaramanga (7.4% +/- 9.9%). As expected, the prevalence of diabetes increased monotonically with age in both men and women (p for the difference among age groups and p-trend both<0.001). For age groups 18-39 and 40-59, men had a numerically higher prevalence of diabetes than women, while in the 60-75 age group the opposite was true (Figure 1). The association between educational level and diabetes prevalence was dependent on sex. Among men, prevalence went from 7.0% for those with elementary education or lower, to 13.8% for those with a professional or higher degree. On the other hand, diabetes prevalence among women decreased steadily with higher education, going from 12.5% in the elementary or lower education group, to 7.2% in the professional or higher educational level group (Figure 2, panel A). Conversely, diabetes prevalence increased with SEL, so that prevalence in the highest SEL almost doubled that of the lowest SEL (Figure 1, panel B) (P-value for the trend in diabetes prevalence with increasing socioeconomic level=0.04.).

Diabetes was more common as BMI increased, going from 8.0% in the normal/underweight category to 12.4% for obesity (p-trend <0.001). While diabetes was almost equally prevalent among normal weight men and women, it was far more common in the male sex in the overweight and obesity categories (Supplemental Figure 2, panel A). Abdominal obesity was strongly associated with diabetes. The relative increase in diabetes prevalence for individuals with

abdominal obesity vs. without it was 65% in men and 163% (2.63-fold) in women (Supplemental Figure 2, panel B).

Unexpectedly, in analyses of dietary nutrient intake, people with diabetes reported a lower consumption of virtually all the nutrients. Consequently, the mean reported daily caloric intake was significantly lower for people with diabetes. This trend was observed for carbohydrates, total lipids, protein, SFA, MUFA, and polyunsaturated fats (PUFA), trans fats, cholesterol, sodium and fiber (Table 2). The mean daily consumption of trans fats by individuals with diabetes (2.0+/-1.2 g/day) was significantly lower than in individuals without diabetes (2.4+/-1.8 g/day, p=0.005), but still much higher than the recommended limit of maximum 1g/day. Similarly, persons with diabetes had a significantly lower intake of dietary sodium (3840+/-1913 mg/day *versus* 5330+/-2767 mg/day, p<0.001). People with diabetes showed a trend towards lower consumption of fiber, that did not reach statistical significance (33.2+/-14.1 g/day *versus* 37.9+/-16.9 g/day, p=0.077).

The macronutrient composition of the diet showed only small variations by diabetes status. For individuals with and without diabetes, the proportions of TCI from each macronutrient were, respectively: Carbohydrates 46.8% *versus* 48.3%, proteins 15.8% *versus* 14.2%, and lipids 36.5% *versus* 36.1%. Only the slightly higher proportion of TCI from protein was statistically significant (p<0.001) (Supplemental Figure 3, panel A). In terms of fat types, there were also very slight differences according to diabetes status. The proportions of TCI coming from each type of fat in individuals with *versus* without diabetes were, respectively: 11.7% versus 11.1% for SFA, 15.9% versus 14.7% for MUFA and 8.1% versus 8.4% for PUFA (Supplemental Figure 3, panel B). The 1.8% higher TCI from MUFA in the diabetes group was statistically significant (p=0.031).

When assessing the compliance of self-reported nutrient intake with current guidelines, the proportion of people with diabetes not meeting the dietary goal for SFA was an alarming 94.4%. Goal non-achievement was similarly high for sodium (86.7%), dietary fiber (84.4%) and trans fats (80%). For protein and MUFA goals, these proportions were lower (45.6 and 16.7%, respectively).

The achievement of dietary goals was associated with demographic factors and with the presence of diabetes (Supplemental Table 1). Men were much less likely to achieve the sodium

(5.4% *versus* 11.4% in women) and fiber (8.5% versus 13.1% in women) recommendations. Participants aged 18 to 39 were less likely to meet the trans fats and sodium recommendations than their older counterparts. Achievement of the trans fats goal was lowest in Bogotá, while for sodium intake the lowest degree of achievement was found in Barranquilla (only 3.8%). Consumption of the recommended amount of dietary fiber was particularly low in Medellin (4.2%). The proportion of people from a high SEL meeting the SFA recommendation was also very low (2.3%). Despite the observed differences in mean nutrient intake between persons with or without diabetes, the degree of goal achievement was only markedly different for sodium (13.3% in diabetes *versus* 8.0 in no diabetes) and protein (54.4% in diabetes *versus* 36.4% in no diabetes).

In a mutually adjusted logistical model that included sex, age, city of residence, BMI, SEL and educational level as covariates, only age group ($p<0.001$) and city of residence ($p=0.019$) were significant predictors of diabetes status. The ORs relative to age group 18-39 were 2.12 (95% CI: 1.09-4.01) for age group 40-59 and 4.28 (95% CI: 2.24-8.19) for age group 60-75. Despite the notorious difference in diabetes prevalence between men and women depending on SEL and educational level, the respective interaction terms were not statistically significant ($p=0.074$ for the sex*SEL interaction, $p=0.24$ for the sex*educational level interaction term). In this model, the adjusted prevalence of diabetes was significantly higher among men than women in the low SEL ($p=0.035$).

After adjusting for sex, age, SEL and BMI, the relative difference in nutrient intake between persons with versus without diabetes ranged between -2.7% for cholesterol and -24.7 for polyunsaturated fatty acids (Figure 3). After adjustment by sex, age, socioeconomic level and body-mass index, however, only the lower consumption of sodium among individuals with diabetes retained statistical significance ($p=0.013$).

Table 2. Daily intake of macronutrients, cholesterol, sodium and fiber, by diabetes diagnosis. SFA: Saturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA: Polyunsaturated fatty acids. Data are means using sampling weights+/- SD.

	Diabetes diagnosis			Univariate p-value
	No	Yes	Difference	
Calories (Cal/Kg/day)	58.5 +/- 31.2	44.1 +/- 22.4	-14.4	<0.001
Carbohydrates (g/Kg/day)	7.08 +/- 3.9	5.18 +/- 3.1	-1.90	0.002
Protein (g/Kg/day)	2.03 +/- 1.2	1.72 +/- 0.8	-0.31	0.076
Lipids (g/Kg/day)	2.35 +/- 1.4	1.79 +/- 1	-0.56	<0.001
SFA (g/Kg/day)	0.73 +/- 0.5	0.58 +/- 0.4	-0.14	0.017
MUFA (g/Kg/day)	0.96 +/- 0.6	0.79 +/- 0.4	-0.17	0.01
PUFA (g/Kg/day)	0.56 +/- 0.4	0.39 +/- 0.3	-0.17	<0.001
Trans fatty acids (mg/day)	2.4 +/- 1.8	2.0 +/- 1.2	-0.41	0.005
Cholesterol (mg/day)	702.5 +/- 494.3	647.8 +/- 442.1	-54.7	0.75
Sodium (mg/day)	5330 +/- 2767	3840 +/- 1913.2	-1490	<0.001
Fiber (g/day)	37.9 +/- 16.9	33.2 +/- 14.1	-4.72	0.077

In nested logistic models, the variables significantly associated with attainment of dietary recommendations were different for each goal in the fully adjusted model (Table 3). Despite the reported lower intake of most nutrients by participants with diabetes, diabetes status only had a significant independent association with meeting the goal for dietary protein (OR 2.03, 95%CI 1.26-3.26). Male sex showed a negative association with meeting the dietary recommendations for sodium (OR 0.45, 95%CI 0.25-0.82), MUFA (OR 0.60, 95%CI 0.41-0.87) and fiber (OR 0.58, 95%CI 0.35-0.96). On the other hand, age was positively associated with meeting the recommendations for TFA (OR 1.019 per year, 95%CI 1.007-1.031), sodium (OR 1.026 per year, 95%CI 1.008-1.044) and fiber (OR 1.036 per year, 95%CI 1.019-1.053). Participants from high SEL were more likely to meet the goals for protein (OR 2.01, 95%CI 1.38-2.93), but less likely to meet the goal for SFA (OR 0.16, 95%CI 0.06-0.42). Individuals with obesity were more likely to reach the dietary protein recommendation (OR 2.02, 95% CI 1.33-3.07). Participants from Cali or Bucaramanga were more likely to attain the TFA goal (compared to Bogota), while those from Medellin were more less likely to meet the dietary fiber goal.

Table 3. Predictors of achievement of different dietary recommendations (goals) in multivariate, mutually adjusted logistic regression models.

	Trans fat <1g/day				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	1.09 (0.75-1.57)	1.09 (0.75-1.58)	1.11 (0.76-1.62)	1.12 (0.76-1.65)	1.12 (0 .76-1.65)
Age (per year)	1.02 (1.00-1.03)	1.02 (1.01-1.03)	1.02 (1.01-1.03)	1.02 (1.01-1.03)	1.02 (1.01-1.03)
SEL (relative to low)					
Medium	-	0.62 (0.39-0.98)	0.62 (0.39-0.98)	0.61 (0.38-0.97)	0.61 (0.38-0.97)
High	-	0.66 (0.42-1.04)	0.63 (0.40-0.99)	0.65 (0.41-1.03)	0.65 (0.41-1.03)
City (relative to Bogotá)					
Medellín	-	-	0.98 (0.55-1.76)	0.97 (0.54-1.75)	0.97 (0 .54-1.76)
Cali	-	-	2.17 (1.28-3.69)	2.12 (1.25-3.62)	2.12 (1.24-3.62)
Barranquilla	-	-	1.26 (0.71-2.23)	1.16 (0.65-2.08)	1.16 (0.65-2.08)
Bucaramanga	-	-	2.50 (1.37-4.56)	2.47 (1.35-4.52)	2.47 (1.35-4.52)
BMI (relative to normal)					
Overweight	-	-	-	1.09 (0.69-1.72)	1.09 (0.69-1.72)
Obesity	-	-	-	1.20 (0.72-1.99)	1.20 (0.72-1.99)
Diabetes	-	-	-	-	0.96 (0.53-1.73)
	Sodium <2300 mg/day				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	0.45 (0.25-0.79)	0.44 (0.25-0.78)	0.45 (0.25-0.80)	0.46 (0.26-0.83)	0.45 (0.25-0.82)
Age (per year)	1.02 (1.01-1.04)	1.02 (1.01-1.04)	1.03 (1.01-1.04)	1.03 (1.01-1.05)	1.03 (1.01-1.04)
SEL (relative to low)					
Medium	-	0.78 (0.39-1.57)	0.73 (0.36-1.47)	0.74 (0.36-1.50)	0.73 (0.36-1.49)
High	-	1.62 (0.88-2.95)	1.58 (0.86-2.91)	1.56 (0.83-2.94)	1.54 (0.81-2.90)
City (relative to Bogotá)					
Medellín	-	-	0.85 (0.40-1.79)	0.80 (0.37-1.74)	0.77 (0.36-1.69)
Cali	-	-	1.08 (0.52-2.25)	1.09 (0.52-2.28)	1.07 (0.51-2.25)
Barranquilla	-	-	0.37 (0.13-1.00)	0.36 (0.13-1.00)	0.36 (0.13-1.00)
Bucaramanga	-	-	1.48 (0.67-3.26)	1.35 (0.60-3.05)	1.35 (0.60-3.06)
BMI (relative to normal)					
Overweight	-	-	-	1.21 (0.64-2.30)	1.24 (0.65-2.37)
Obesity	-	-	-	1.07 (0.51-2.22)	1.08 (0.52-2.26)
Diabetes	-	-	-	-	1.50 (0.73-3.08)
	Protein >=15% of TCI				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	1.03 (0.77-1.39)	1.02 (0.76-1.38)	1.04 (0.77-1.41)	1.15 (0.84-1.57)	1.13 (0.82-1.54)
Age (per year)	1.00 (0.99-1.01)	1.00 (0.99-1.01)	1.00 (0.99-1.01)	1.00 (0.99-1.01)	1.00 (0.99-1.01)
SEL (relative to low)					
Medium	-	1.24 (0.85-1.79)	1.22 (0.84-1.77)	1.25 (0.86-1.83)	1.25 (0.85-1.83)
High	-	1.93 (1.35-2.77)	1.94 (1.35-2.79)	2.08 (1.43-3.02)	2.01 (1.38-2.94)
City (relative to Bogotá)					
Medellín	-	-	0.88 (0.57-1.36)	0.90 (0.58-1.39)	0.83 (0.53-1.30)
Cali	-	-	1.22 (0.78-1.89)	1.12 (0.72-1.75)	1.11 (0.71-1.74)
Barranquilla	-	-	0.76 (0.48-1.19)	0.68 (0.43-1.07)	0.68 (0.43-1.09)
Bucaramanga	-	-	1.15 (0.70-1.91)	1.06 (0.63-1.77)	1.07 (0.64-1.80)
BMI (relative to normal)					
Overweight	-	-	-	1.07 (0.74-1.54)	1.09 (0.75-1.58)
Obesity	-	-	-	2.02 (1.33-3.06)	2.02 (1.33-3.07)
Diabetes	-	-	-	-	2.03 (1.26-3.26)

	SFA <7% of TCI				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	1.25 (0.73-2.14)	1.27 (0.74-2.19)	1.27 (0.74-2.2)	1.24 (0.71-2.19)	1.26 (0.71-2.22)
Age (per year)	1.01 (1.00-1.03)	1.02 (1.00-1.03)	1.02 (1.00-1.03)	1.01 (1.00-1.03)	1.02 (1.00-1.03)
SEL (relative to low)					
Medium	-	0.60 (0.33-1.10)	0.59 (0.32-1.10)	0.59 (0.32-1.10)	0.59 (0.32-1.11)
High	-	0.16 (0.06-0.42)	0.15 (0.06-0.41)	0.16 (0.06-0.41)	0.16 (0.06-0.42)
City (relative to Bogotá)					
Medellín	-	-	0.64 (0.27-1.52)	0.63 (0.25-1.55)	0.64 (0.26-1.58)
Cali	-	-	1.05 (0.48-2.29)	1.11 (0.51-2.45)	1.13 (0.51-2.49)
Barranquilla	-	-	1.19 (0.55-2.58)	1.24 (0.57-2.71)	1.22 (0.56-2.67)
Bucaramanga	-	-	1.32 (0.52-3.30)	1.25 (0.50-3.16)	1.22 (0.48-3.10)
BMI (relative to normal)					
Overweight	-	-	-	2.02 (1.03-3.94)	2.01 (1.03-3.91)
Obesity	-	-	-	0.89 (0.38-2.07)	0.91 (0.39-2.14)
Diabetes	-	-	-	-	0.55 (0.19-1.64)
	MUFA >=12% of TCI				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	0.64 (0.45-0.92)	0.63 (0.44-0.90)	0.62 (0.44-0.90)	0.61 (0.42-0.88)	0.60 (0.41-0.87)
Age (per year)	0.99 (0.98-1.00)	0.99 (0.98-1.00)	0.99 (0.98-1.00)	0.99 (0.98-1.00)	0.99 (0.98-1.00)
SEL (relative to low)					
Medium	-	1.35 (0.89-2.05)	1.35 (0.88-2.06)	1.31 (0.85-2.00)	1.30 (0.85-2.00)
High	-	2.34 (1.47-3.72)	2.46 (1.54-3.95)	2.38 (1.48-3.83)	2.32 (1.44-3.74)
City (relative to Bogotá)					
Medellín	-	-	0.67 (0.40-1.11)	0.68 (0.41-1.14)	0.66 (0.39-1.10)
Cali	-	-	0.71 (0.42-1.20)	0.71 (0.42-1.22)	0.71 (0.41-1.20)
Barranquilla	-	-	1.03 (0.59-1.82)	1.05 (0.59-1.86)	1.06 (0.60-1.88)
Bucaramanga	-	-	0.45 (0.25-0.81)	0.46 (0.26-0.83)	0.47 (0.26-0.84)
BMI (relative to normal)					
Overweight	-	-	-	0.84 (0.55-1.29)	0.86 (0.56-1.32)
Obesity	-	-	-	0.85 (0.52-1.40)	0.84 (0.51-1.38)
Diabetes	-	-	-	-	1.70 (0.91-3.19)
	Fiber >=14 g / 1000 Cal				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	0.61 (0.37-0.99)	0.61 (0.37-0.99)	0.62 (0.38-1.01)	0.58 (0.35-0.97)	0.58 (0.35-0.96)
Age (per year)	1.03 (1.02-1.05)	1.03 (1.02-1.05)	1.04 (1.02-1.05)	1.04 (1.02-1.05)	1.04 (1.02-1.05)
SEL (relative to low)					
Medium	-	1.04 (0.57-1.89)	0.94 (0.51-1.73)	0.91 (0.49-1.69)	0.91 (0.49-1.68)
High	-	1.52 (0.86-2.68)	1.53 (0.86-2.72)	1.47 (0.82-2.64)	1.46 (0.81-2.61)
City (relative to Bogotá)					
Medellín	-	-	0.21 (0.08-0.51)	0.21 (0.08-0.52)	0.21 (0.08-0.51)
Cali	-	-	0.7 (0.36-1.34)	0.72 (0.37-1.4)	0.71 (0.37-1.39)
Barranquilla	-	-	0.53 (0.26-1.07)	0.54 (0.27-1.11)	0.55 (0.27-1.11)
Bucaramanga	-	-	0.68 (0.31-1.5)	0.69 (0.31-1.53)	0.69 (0.31-1.53)
BMI (relative to normal)					
Overweight	-	-	-	1.09 (0.62-1.92)	1.09 (0.62-1.92)
Obesity	-	-	-	0.76 (0.39-1.49)	0.76 (0.38-1.48)
Diabetes	-	-	-	-	1.31 (0.67-2.56)

Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model 3 had all variables in model 2 plus BMI, model 4 had all variables in model 3 plus city, and model 5 had all variables in model 4 plus diabetes status. Data are OR (95%CI).TCI: Total caloric intake.

DISCUSSION

We performed a population-based study to describe diabetes prevalence and associated dietary nutrient ingestion patterns in five Colombian cities representing the main regions of the country. We found an overall prevalence of 10.1% based on self-reported diabetes and random plasma glucose measurements. Diabetes was more common with older age, higher SEL, excess body weight, abdominal obesity, and among residents of Medellin. The association between diabetes prevalence and education was dependent on sex: A higher educational level was associated with a lower prevalence of diabetes among women and with a higher prevalence of diabetes among men. People with diabetes reported significantly less caloric intake than those without diabetes, a difference was also present for most macronutrients, but retained statistical significance after adjustment only in the case of dietary sodium. When compared with current guidelines, the proportion of individuals with diabetes not achieving dietary recommendations for SFA, MUFA, trans fats, fiber and sodium among individuals with diabetes was remarkably high. We also found that the Odds of achieving dietary recommendations were largely influenced different by sex, age group, city of residence and, in the case of dietary protein, diabetes status.

The reported prevalence of diabetes in Colombia varies widely across different studies and official documents, reflecting a lack of accurate population-level data, a problem common to many developing countries. The International Diabetes Federation Diabetes Atlas 2019 estimated an adjusted diabetes prevalence of 7.4% for the Colombian population (36), and the World Health Organization in its 2016 Diabetes Country Profiles reported a total prevalence of 8.0% (12). Meanwhile, the above-mentioned PURE study reported a prevalence of 11.1% for the population aged 35 to 70 from upper-middle income countries (13), much higher than the national survey done by Colombian government in 2007 (37), which found a 3.5% prevalence of self-reported diabetes in adults aged 18 to 69 (38). Results from regional studies are similarly heterogeneous. The CARMELA Study, a population-based study in large Latin American cities, found a diabetes prevalence of 8.1% in Bogotá in 2006 (39), similar to the 8.9% found in the Colombian Caribbean city of Cartagena in 2005 (40). A comparison of our findings with prior studies reveals that the diabetes epidemic seems to be progressing faster in smaller cities in Latin America. For example, diabetes prevalence in a 2006 study of adults in Bucaramanga was only 4%, while we found 7.4%

in the same city (41). We found a comparable diabetes prevalence for most of the cities except for Medellin, where we found a much larger figure. A population study undertaken in Medellin and its suburbs in 2008-2010 (42) found a prevalence of high plasma glucose (fasting plasma glucose >100 mg/dL or taking antidiabetic medication) of 19.8%, quite comparable to our 20.1% by diabetes self-report or random plasma glucose>200 mg/dL, despite the different definition. By comparison with results from both IDF and WHO estimates and from national studies, our results seem to confirm a sizable increase in the prevalence of diabetes in Colombian cities. Further studies are needed in order to identify potential genetic, demographic or cultural reasons for the high prevalence of hyperglycemia in this region of the country.

Worldwide, the prevalence and societal burden of diabetes have been increasing steadily in recent years. Diabetes has moved from being the tenth most relevant cause of disability-adjusted life years (DALYs) lost in 1990, to being the fourth in 2005, and the third in 2015 (43). The rapid expansion of the diabetes epidemic is being driven mostly by small prevalence increases in largely populated Asian countries (China and India) (44), but also by sustained prevalence increases in developed countries in Europe and North America. According to the IDF Diabetes Atlas 2019, diabetes prevalence among adults in the North America and Caribbean region was estimated at 13.3%, while in Europe it was 8.9% (36). The most recent estimate of the US Centers for Disease Control places diabetes prevalence in the USA at 13.0% (45). Thus, our estimations worryingly place the prevalence of diabetes among urban adults from Colombia at a level close to that of developed countries, and to that of Latin American countries traditionally leading diabetes prevalence statistics like Brazil (11.4%) and Mexico (15.1%) (36). Overall, our study led to an estimate of diabetes prevalence much more plausible and coherent with international projections than data from existing national health surveys.

The most important independent correlate of diabetes in our study was increasing age, as has been described for most populations worldwide (43). Our study found an estimated prevalence of diabetes among older adults remarkably close to that encountered in recent surveys from the SABE study (17.5% in SABE Bogotá, executed in 2012 (20); 18.5% in SABE Colombia, executed in 2015 (19) and 20.6% in COPEN, executed in 2018). Thus, recent data support the idea of an accelerated increase in the prevalence of diabetes among older adults in Colombia. For the most

part, the relationship between socioeconomic status and diabetes is consistent in high-income countries: a lower position increases risk (46-49). Meanwhile, the magnitude and direction of this association in middle- and low-income countries is conflicting across studies, perhaps due to imperfect data, to the use of different proxies for SEL, or to the rapid development of demographic and nutritional transitions that affect them in ways different from what takes place in the developed world (50-52). In Colombia, the higher prevalence of *diagnosed* diabetes with higher SEL may be explained at least partially by increased access to medical care and diabetes screening with higher income (53).

Prior studies had found an interaction between sex and educational level, so that more educated women had a lower prevalence of diabetes. A large multi-national study reported increasing odds of diabetes as education increased among men from middle-income countries. For women, the association was flat or slightly negative (54). Other studies of the associations between socioeconomic variables and diabetes have also found a different pattern according to sex (55,56). Studies from Mexico (57) Argentina (58) and Brazil (59) have also documented higher rates of obesity and diabetes among more educated males and less educated females. Many factors could explain these results, but one that may apply to our context is a larger degree of body dissatisfaction among women, that increases with higher education. A study in Bogotá showed that women with higher education were more likely to identify thinner body silhouettes as their preferred ones (60). Our results complement a body of evidence suggesting that education of women may be a tool in the fight against the diabetes epidemic in developing countries.

We were surprised to find a lower self-reported weight-adjusted intake of calories and all macronutrients among persons with diabetes. An optimistic interpretation of this finding would be that it shows good adherence to dietary recommendations. However, such interpretation should be made with caution, as it is known that people with diabetes and obesity frequently underreport their caloric intake (61).

The fact that the lower mean intake of all nutrients but sodium in people with diabetes lost significance after multivariate adjustment, suggests that major sociodemographic factors (older age) and a higher BMI are the main factors explaining a lower reported dietary intake in persons

with diabetes. In any event, these differences did not result in increased odds of achieving dietary recommended intakes of key nutrients, as only reaching the %TCI from protein was independently associated with diabetes status.

Despite reporting quantitatively less intake of most nutrients, the relative proportion of macronutrients from each source in participants with diabetes was remarkably similar to that of people without diabetes. This finding also applied to fat subtypes: SFA, MUFA and PUFA represented a comparable share of TCI regardless of diabetes status. This points out that individuals with diabetes (many of whom know already know about of their diabetes status), are not modifying enough their diets to intentionally increase the percent of Calories from MUFA, as well as reducing their intake of SFA and TFA. A survey of patients with type 2 diabetes from general practices in the Netherlands found a 15% mean TCI from SFA at the moment of diagnosis, which had descended to 11.9% by four years after diagnosis (62). This is still far from the recommendation of <7% TCI from SFA. Thus, excessive consumption of SFA by people with diabetes seems to be a ubiquitous problem.

The intake of dietary fiber was equally concerning, in this case because of too little consumption, a problem that was more evident in participants who were younger, male, or lived in Medellin. A meta-analysis of randomized controlled trials concluded that diets with foods rich in fiber up to 42.5 g/day reduced glycated hemoglobin by a mean 0.55% and fasting plasma glucose by 9.9 mg/dL in persons with diabetes (63). Hence, a low consumption of dietary fiber constitutes a lost opportunity for improving the health of persons with diabetes. Dietary TFA are a powerful cardiovascular risk factor, even at intakes as low as 2% of TCI. For this reason, their intake is restricted by most dietary guidelines to less than 1g/day, with special emphasis on populations at high baseline risk for cardiovascular disease, like people with diabetes or older people (64). We found that only one in every five individuals with diabetes was achieving this goal, and the odds of achieving it were significantly lower with younger age or higher SEL, probably in relation with a higher consumption of processed, industrialized foods (64). TFA intake is an independent predictor of total and cardiovascular mortality (65), so extreme efforts should be put in place in order to limit their consumption both in the general population and among persons with diabetes.

Our results bring out many areas of potential intervention for nutritional prevention, which are particularly relevant in our context. Nutritional education of people with diabetes in developing countries is an urgent measure with large potential benefits and minimal risks.

Limitations of our study include the entirely urban sample, given the recent increase in obesity in rural areas in the continent (66) and Colombia (67). It is important, however, that the proportion of total population living in urban centers is in Colombia is 77.1% (68), a result of accelerated urbanization induced by years of internal conflict that has impacted the epidemiologic profile of the country (14). Another relevant limitation was the unavailability of oral glucose tolerance test (OGTT) data, so our ascertainment of diabetes status relied on random plasma glucose measurement and diabetes self-report, which may lead to underestimation of the true disease prevalence. OGTT is the most sensitive test for diabetes diagnosis but performing it would have imposed great complexities on the logistics of the study. We acknowledge that the prevalences we report, high as they seem, are most likely an underestimation. Concerning the instrument to measure dietary intake, FFQs have the advantage of inquiring about usual (rather than recent) intake, to be more comprehensive than 24-hour dietary recalls, and not as susceptible to modification by recent diet as food diaries. They do have the limitations of tending to overestimate total Caloric intake, and of having to be adjusted for different populations. However, the problems inherent to recall bias exist for all dietary assessment tools, except for food diaries, which are seldom used in epidemiology. FFQs have been shown to successfully assess average dietary intake up to 4 years prior to their application (69). Finally, our study did not collect detailed information on lifestyle variables like smoking or physical activity, which may explain or correlate with the described dietary intakes.

In summary, our results confirm a continued progression of the diabetes epidemic in middle-income countries, and its relationship with demographic and socioeconomic factors. We also found remarkably low rates of achievement of key nutritional goals among individuals with diabetes, and identified factors associated with their achievement. Further research focused in rural areas is needed in order to build a complete the picture of evolution of the diabetes epidemic in the developing world.

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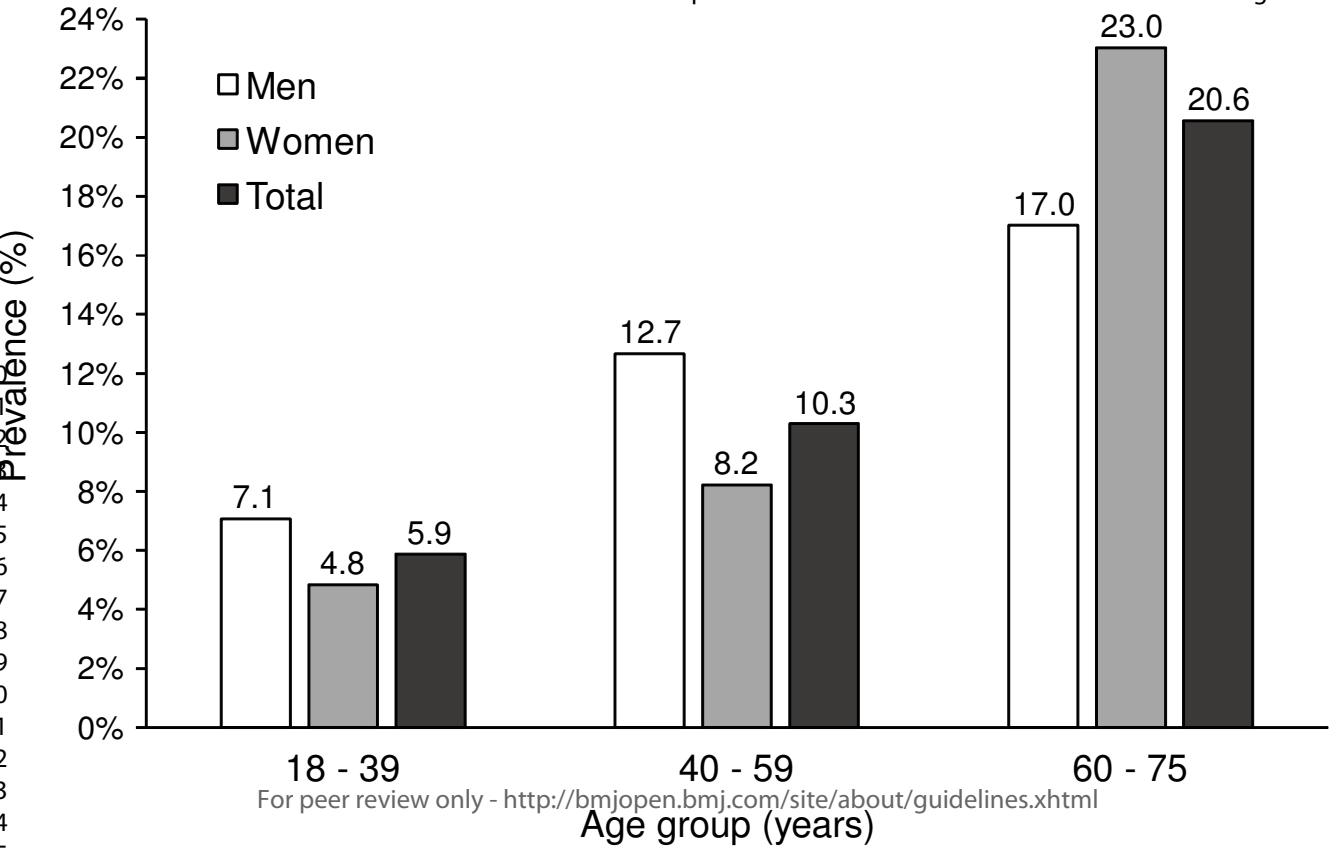
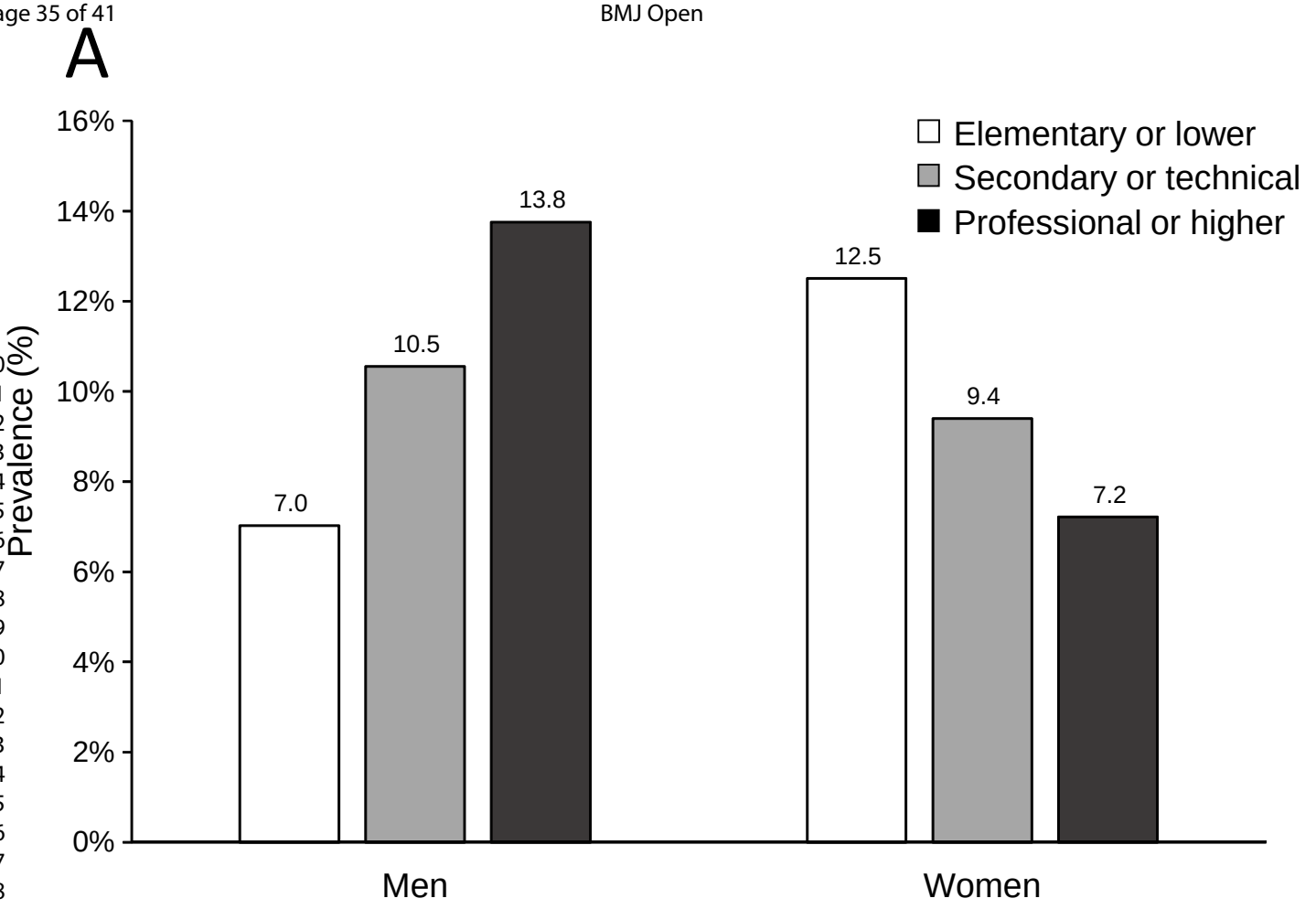
Figure legends

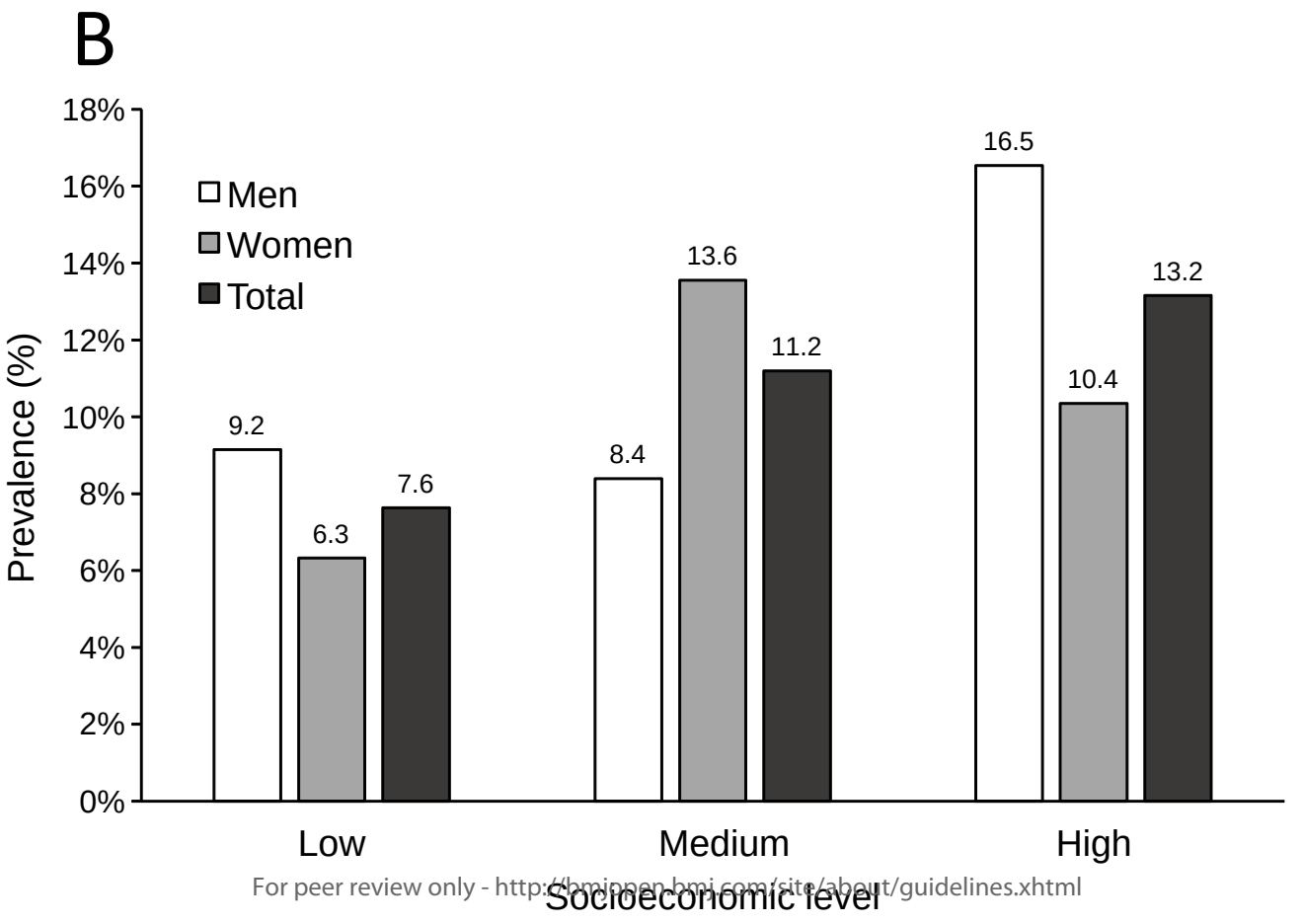
Figure 1. Prevalence of diabetes, by age and sex. Data are prevalences using sampling weights. P-value for the overall difference in prevalence among age groups <0.001. P-value for the trend in diabetes prevalence with increasing age group <0.001.

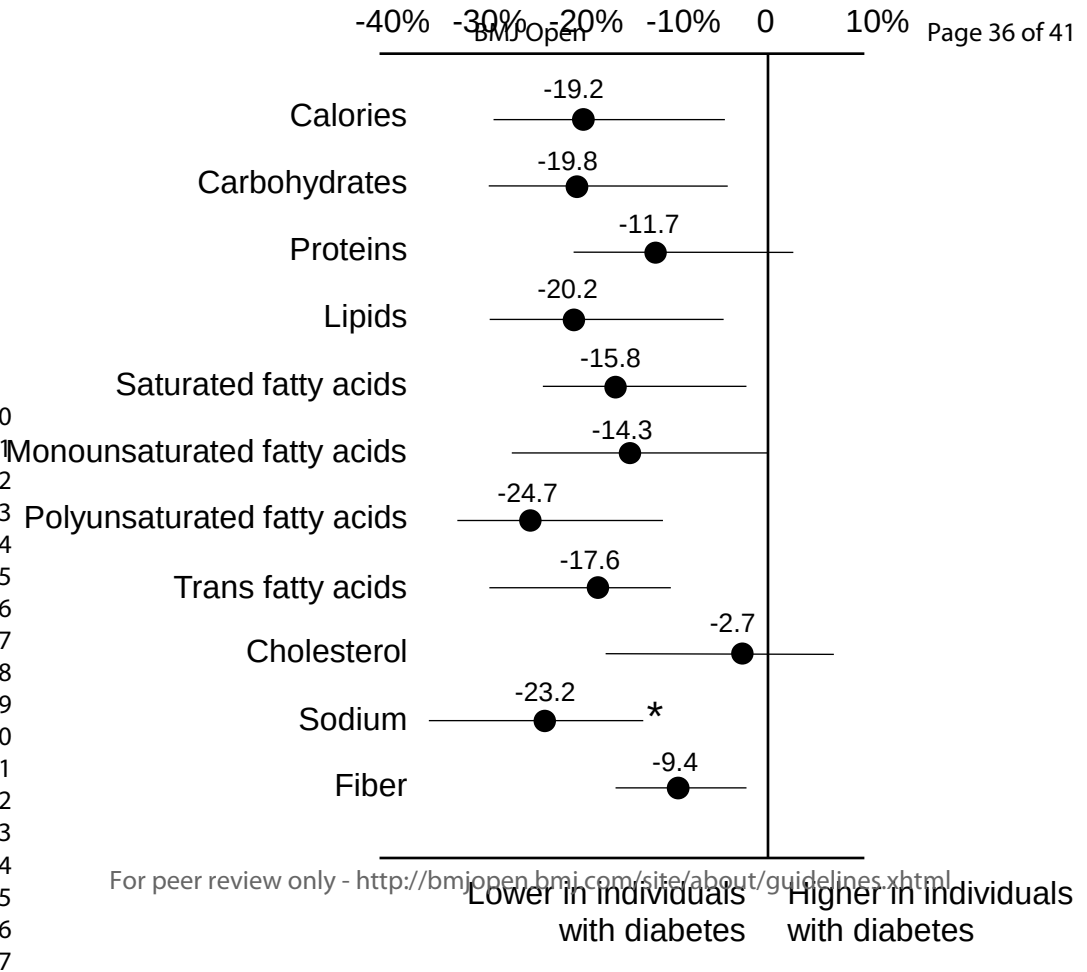
Figure 2. Prevalence of diabetes, by educational level (Panel A) and socioeconomic level (Panel B), and sex. Educational level refers to the highest level completed. Socioeconomic level (SEL) was classified according to Colombia´s official Statistics Department-DANE stratification scheme. Low SEL includes strata 1 and 2, medium SEL includes only stratum 3, and high SEL includes strata 4, 5 and 6. Data are prevalences using sampling weights. P-value for the overall difference in diabetes prevalence among socioeconomic levels=0.11. P-value for the trend in diabetes prevalence with increasing socioeconomic level=0.04.

Figure 3. Difference in age, sex, BMI and SEL-adjusted nutrient intake (in g/d), between individuals with diabetes and individuals without diabetes. Dots represent medians and lines represent Q1-Q4. *p=0.013 for the adjusted comparison versus individuals without diabetes.





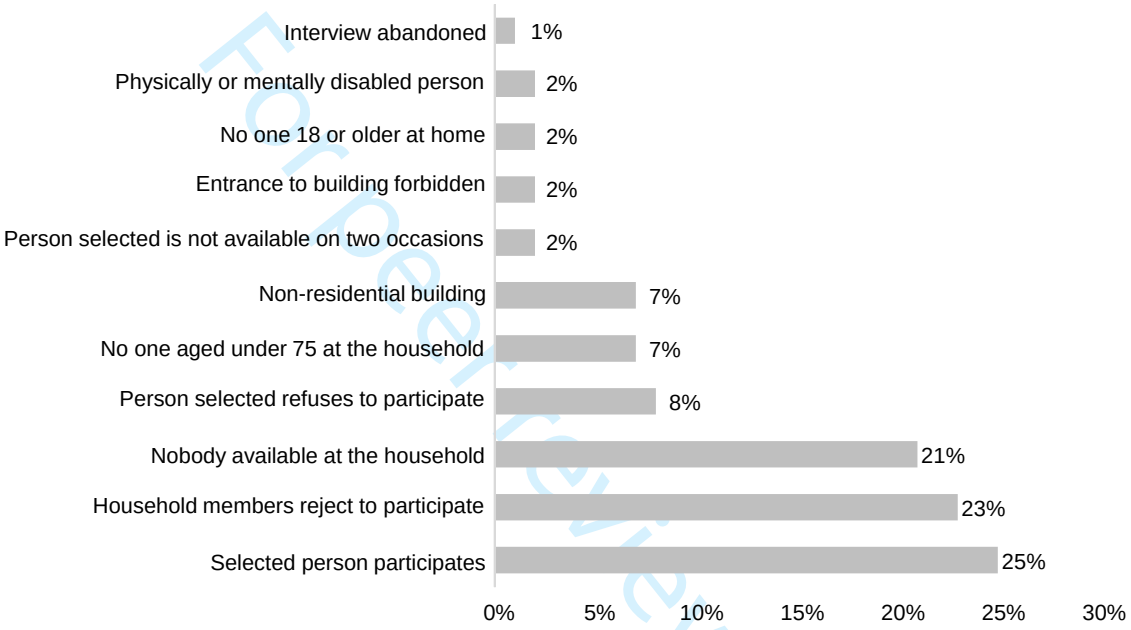




Dietary intake among urban adults with diabetes: COPEN (Colombian Nutritional Profiles), a cross-sectional study

Supplementary Material

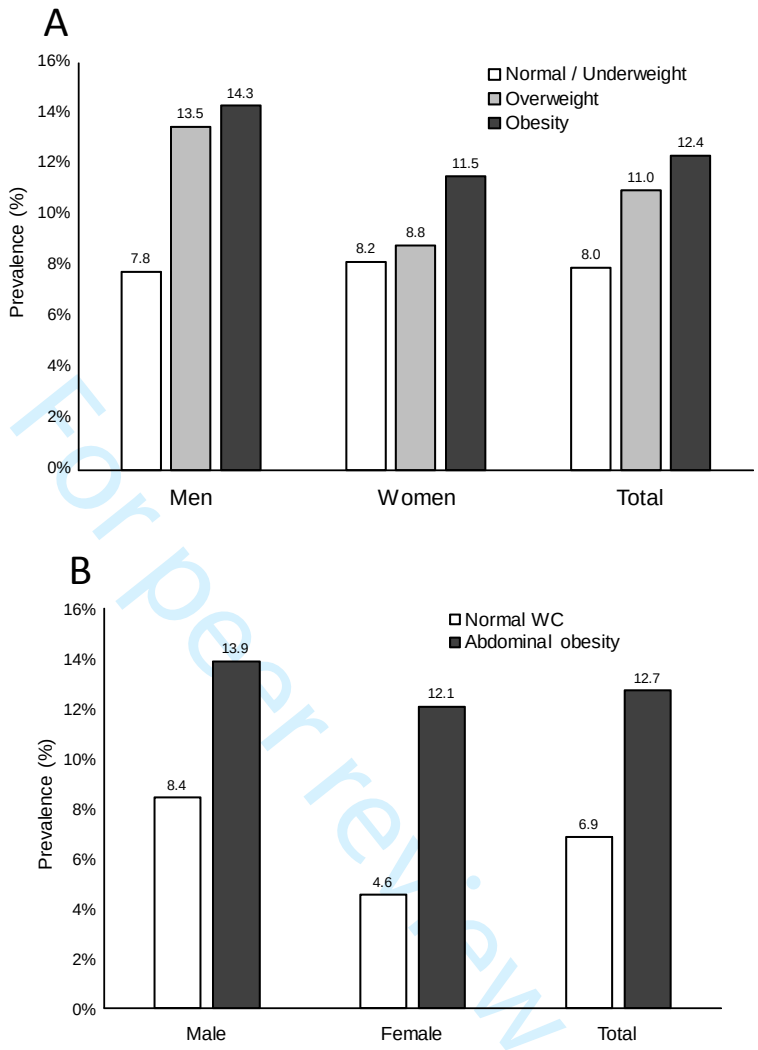
Supplemental Figure 1. Results of 7640 contacts for recruitment of study participants.



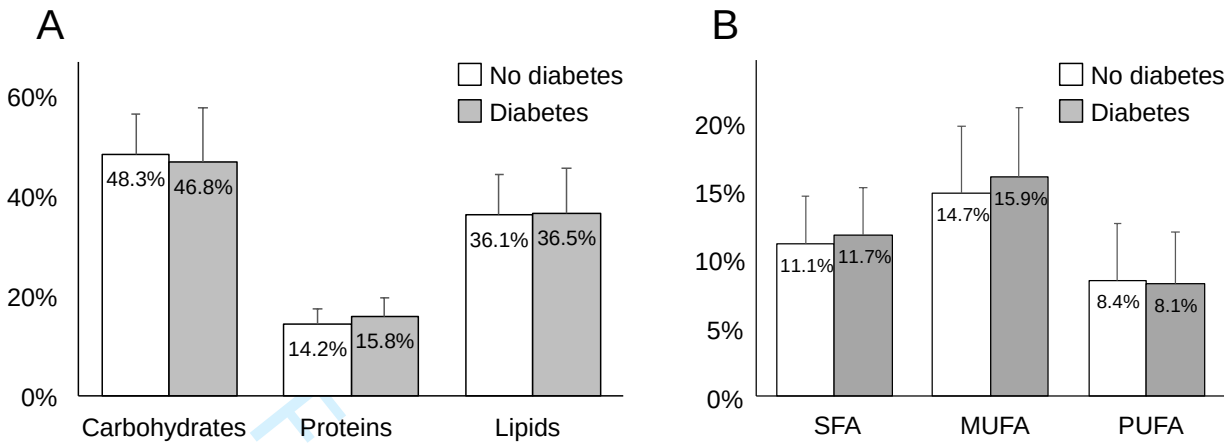
Supplemental table 1. Proportion of individuals achieving different dietary recommendations, according to sex, age group, city, SEL and educational level.

		Trans fat <1g/day	Sodium <2300 mg/day	Protein >=15% of TCI	SFA <7% of TCI	MUFA >=12% of TCI	Fiber >=14 g / 1,000 Cal
Sex	Male n=331	66 (19.9%)	18 (5.4%)	129 (39%)	29 (8.8%)	246 (74.3%)	28 (8.5%)
	Female n=405	76 (18.8%)	46 (11.4%)	155 (38.3%)	29 (7.2%)	331 (81.7%)	53 (13.1%)
Age group	18 to 39 n=288	42 (14.6%)	14 (4.9%)	103 (35.8%)	20 (6.9%)	234 (81.3%)	14 (4.9%)
	40 to 59 n=235	52 (22.1%)	30 (12.8%)	101 (43%)	14 (6%)	179 (76.2%)	33 (14%)
	60 to 75 n=213	48 (22.5%)	20 (9.4%)	80 (37.6%)	24 (11.3%)	164 (77%)	34 (16%)
City	Bogotá n=250	37 (14.8%)	23 (9.2%)	97 (38.8%)	20 (8%)	205 (82%)	39 (15.6%)
	Medellin n=142	22 (15.5%)	12 (8.5%)	51 (35.9%)	8 (5.6%)	106 (74.6%)	6 (4.2%)
	Cali n=126	35 (27.8%)	13 (10.3%)	54 (42.9%)	11 (8.7%)	96 (76.2%)	15 (11.9%)
	Barranquilla n=132	24 (18.2%)	5 (3.8%)	44 (33.3%)	12 (9.1%)	109 (82.6%)	12 (9.1%)
	Bucaramanga n=86	24 (27.9%)	11 (12.8%)	38 (44.2%)	7 (8.1%)	61 (70.9%)	9 (10.5%)
SEL	Low n=297	67 (22.6%)	22 (7.4%)	96 (32.3%)	35 (11.8%)	218 (73.4%)	26 (8.8%)
	Medium n=219	37 (16.9%)	15 (6.8%)	82 (37.4%)	18 (8.2%)	170 (77.6%)	24 (11%)
	High n=220	38 (17.3%)	27 (12.3%)	106 (48.2%)	5 (2.3%)	189 (85.9%)	31 (14.1%)
Educational level	Elementary or lower n=156	45 (28.8%)	16 (10.3%)	53 (34%)	20 (12.8%)	104 (66.7%)	16 (10.3%)
	Secondary or technical n=427	73 (17.1%)	28 (6.6%)	158 (37%)	28 (6.6%)	339 (79.4%)	47 (11%)
	Professional or higher n=153	24 (15.7%)	20 (13.1%)	73 (47.7%)	10 (6.5%)	134 (87.6%)	18 (11.8%)
Diabetes	Yes n=90	18 (20%)	12 (13.3%)	49 (54.4%)	5 (5.6%)	75 (83.3%)	14 (15.6%)
	No n=646	124 (19.2%)	52 (8%)	235 (36.4%)	53 (8.2%)	502 (77.7%)	67 (10.4%)

Data are n (%).



Supplemental Figure 2. Prevalence of diabetes, by body-mass index (Panel A) and waist circumference (Panel B) status. Underweight was defined as a body mass index (BMI) of less than 18.5 Kg/m^2, normal weight as a BMI between 18.5 and less than 25 Kg/m^2, overweight as a BMI between 25 and less than 30 Kg/m^2, and obesity as a BMI of 30 or higher. Abdominal obesity was defined as a waist circumference of 90 cm or higher in women, and 94 cm or higher in men. Data are prevalences using sampling weights.



Supplemental Figure 3. Distribution of total caloric intake (TCI) from each macronutrient (Panel A) and percent TCI from each fat type (Panel B) according to diabetes status. SFA: Saturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA: Polyunsaturated fatty acids. $p<0.001$ for the difference in percent TCI from protein, and $p=0.031$ for the difference in percent TCI from MUFA.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Page 1, line 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found Page 2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Pages 5-7
Objectives	3	State specific objectives, including any prespecified hypotheses Page 7, line 160
Methods		
Study design	4	Present key elements of study design early in the paper Page 7, line 167
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Pages 8-10
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants Page 8, lines 175-185
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Page 9, lines 200-235
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Page 9, lines 200-235
Bias	9	Describe any efforts to address potential sources of bias Page 8, lines 171-179
Study size	10	Explain how the study size was arrived at Page 8, lines 179-181
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Page 9, lines 200-235
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding Page 11, lines 259-283
		(*b*) Describe any methods used to examine subgroups and interactions Page 11, lines 267-272
		(*c*) Explain how missing data were addressed

		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy Page 11, line 259-260
		(*e*) Describe any sensitivity analyses
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Supplemental Figure 1
		(b) Give reasons for non-participation at each stage Supplemental Figure 1
		(c) Consider use of a flow diagram Supplemental Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Table 1, Page 13
		(b) Indicate number of participants with missing data for each variable of interest Not applicable
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures Page 14, lines 309-323
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included Page 14, lines 333-341
		(*b*) Report category boundaries when continuous variables were categorized Page 13, Table 1
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses Page 15, lines 355-369
Discussion		
Key results	18	Summarise key results with reference to study objectives Page 19, lines 409-422
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Page 23, lines 532-546
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Pages 19, 20, 21
Generalisability	21	Discuss the generalisability (external validity) of the study results Page 20, lines 460-473
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based Page 1, line 19

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Diabetes and associated dietary intake among urban adults: COPEN (Colombian Nutritional Profiles), a cross-sectional study

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Diabetes and associated dietary intake among urban adults: COPEN (Colombian Nutritional Profiles), a cross-sectional study

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ABSTRACT

Objectives: Diabetes is increasing rapidly in developing countries. We aimed to estimate the prevalence of diabetes, describe its correlates and its associated dietary intake in urban adults from Colombia.

Setting: The Colombian Study of Nutritional Profiles (COPEN) was a population-based, cross-sectional, multi-stage probabilistic sampling survey designed to represent the five main Colombian cities.

Participants: Between June and November 2018, we studied 736 non-pregnant participants aged 18 or older. Diabetes was defined as a random plasma glucose >= 200 mg/dL, self-reported prior diagnosis of diabetes or use of any oral or injectable antidiabetic medication(s). Participants also fulfilled a detailed 157-item food frequency questionnaire (FFQ).

Primary and secondary outcome measures: Prevalence of diabetes, dietary intake of key nutrients, achievement of dietary goals among individuals with diabetes.

Results: The overall estimated prevalence of diabetes was 10.1%, with no difference by sex (9.6% in women, 10.8% in men, p=0.43). The association between diabetes and education level depended on sex, diabetes was more prevalent among more educated men and less educated women. Abdominal obesity was associated with a 65% increase in diabetes prevalence among men, and a 163% increase in women. Individuals with diabetes reported lower mean consumption of all nutrients, but after adjustment by sex, age, socioeconomic level and body-mass index, only their lower sodium consumption remained significant (p=0.013). The proportion of non-achievement of dietary intake goals among participants with diabetes was 94.4% for saturated fats, 86.7% for sodium, 84.4% for fiber and 80% for trans fats. In multivariate logistic regression models, age was the strongest independent correlate of diabetes.

Conclusions

Diabetes by self-report, random plasma glucose or medication use was highly prevalent among Colombian adults. There were large differences by abdominal obesity status, region of residence,

SEL and educational level. The proportion of individuals with diabetes meeting dietary recommendations was alarmingly low.

Strengths and limitations of this study

- The study explored the prevalence of diabetes and its associated dietary nutrient intake, as well as their relationship to key demographic factors.

- The study had a population-based, probabilistic sample from five cities in Colombia.

- Dietary intake was assessed with a food frequency questionnaire adapted to national and regional dietary habits, and inquiring about usual behavior, rather than recent intake.

- Random plasma glucose and self-reported diabetes may underestimate the real diabetes prevalence compared to oral glucose tolerance tests or glycated hemoglobin measurement.

- Our study did not include any participants from rural areas, whose diabetes prevalence and associated diet may differ significantly from those of urban populations.

Data sharing statement

The study dataset and its associated variable definitions file have been publicly deposited in the dryad repository, they can be consulted under the following link:
https://doi.org/10.5061/dryad.sqv9s4n2n
All questions about these data are welcome and should be directed to corresponding author.

INTRODUCTION

The number of deaths attributed to diabetes in the year 2010 was 3.96 million, on average every eight seconds one person died from diabetes somewhere in the world (1). It is estimated that, if current trends persist, 700 million adults will live with diabetes by 2045 (2). As life expectancy increases, the number of older adults with diabetes will rise from 136 million to 276 million (2).

In South and Central America, the age-adjusted prevalence of diabetes has been estimated at 8.5% in 2019 and is expected to advance to 9.9% by 2045 (2,3). Brazil and Mexico, the most populated countries in the region, occupy respectively the fifth and sixth position in the ranking of countries with the most people with diabetes worldwide (2). The prevalence of diabetes varies widely across Latin American countries. Current data show that Puerto Rico and Mexico are the countries with the highest prevalence in the region (13.7% and 13.5% respectively), while Ecuador (5.5%) and Argentina (5.9%) have the lowest (1, 4-8). Latin America is the region where diabetes represents the largest proportion of total health expenditure (around 20% of total) (2). The cost of diabetes in Latin America and the Caribbean in 2015 was estimated at 103-142 billion dollars, a 6 to 7-fold increase relative to 2000 (9). Rapid urbanization and aging are the two main drivers of the diabetes epidemic in Latin America (10).

It is expected that, over the coming decades, the largest increase in people with diabetes will occur in countries experimenting the low to middle-income transition (1,11, 12). The Prospective Urban and Rural Epidemiology (PURE) study found that lower-income countries had the highest age and sex-adjusted prevalence of diabetes (average 12.3%), followed by upper-middle (average 11.1%,), lower-middle (average 8.7%) and high income countries (average 6.6%) (13).

Colombia is a South American country of about 48 million inhabitants, in which no recent population-based studies exploring the prevalence of diabetes or the comparative characteristics of dietary intake among individuals with diabetes are available. In Colombia, the urbanization phenomenon has been further complicated by the internal displacement of hundreds of thousands of citizens as a result a protracted internal conflict that only came to an end in the recent years (14). The estimated cost of diabetes in Colombia is the fourth largest in the region below Brazil,

Mexico and Venezuela (9). The official sources of information about the burden of diabetes in Colombia are not population-based studies, but claim databases like the High-Cost Account (*Cuenta de Alto Costo* - CAC) (15), a registry kept by an association of Colombian health insurance companies. Another frequently cited source is SISPRO (*Sistema Integrado de Información de Protección Social* - Integrated Social Protection Information System) (www.sispro.gov.co), a database that compiles all health services and procedures provided by the Colombian health system (16). These sources are useful for planning the provision of health services, but they cannot provide estimations of diabetes and its associated factors at the population level. For instance, the CAC reported a diabetes prevalence of 2.2% between July 2016 and June 2017, a figure far removed from all worldwide data in similar countries and from IDF projections (2,5,17,18). Similarly, these official sources based on care provision do not register relevant lifestyle variables, so they do not allow the exploration of dietary habits of people with diabetes in the general population. There are, however, some sources of estimates for the population prevalence of diabetes, but they are confined to a specific population group. Thus, the SABE (from the Spanish SAlud, Bienestar y Envejecimiento – Health, well-being and ageing) Colombia study found a rate of self-reported diabetes of 18.5% among adults aged over the age of 60 in 2015 (19). A similar prevalence (17.5%) was found in the SABE Bogotá survey of older adults in the country´s capital (20).

In Colombia, population-based surveys have demonstrated a notorious increase in both child and adult obesity over the last two decades (21). Such increases parallel those observed in Mexico and other Latin-American countries, suggesting that the recent phenomena of mass urbanization, westernization of dietary habits and adoption of sedentary behaviors are translating into a demographic and nutrition transition in the whole region (22). These changes have disproportionately affected more economically vulnerable segments of the population (23).

In addition to the recent rise in obesity, Colombia has also experienced a slow but sustained increase in life expectancy that started in the second half of the 20th century, especially among women (24). The combination of these factors greatly favors the development of diabetes and other chronic diseases, hence the exploration of the current of diabetes and its associated dietary behaviors is of great importance.

Dietary behavior is a crucial determinant of the degree of control and the development of chronic complications among individuals with diabetes. Dietary habits have a large impact on various parameters directly related to the risk of chronic complications, among them blood glucose levels, plasma lipids and blood pressure (25). Hence, the adequate documentation and exploration of the dietary habits of this population is of the utmost importance to guide clinical strategies and public health policies aimed at persons with diabetes. Despite the multiple combinations of macronutrients that may be adjusted to each person´s requirements and cultural preferences, most guidelines agree on a few universal goals whose attainment predicts a larger probability of diabetes control, and prevention of chronic complications (26). These goals usually comprise the distribution of calories among the different macronutrients, the restriction of dietary trans fats, sodium and cholesterol, and the provision of an adequate amount of dietary fiber. We expected that most persons with diabetes would attain these dietary goals in Colombian cities. Also, given the known association of diabetes with excess body weight and hence a net positive caloric balance, we expected caloric and nutrient intake to be higher among individuals with diabetes.

Colombia is a geographically, racially and culturally diverse country with marked differences among the five most populated regions: i. Central plateau (administrative and economic center of the country), ii. Caribbean region, with culture and costumes similar to those of Caribbean nations, iii. Pacific coast, a very industrialized region but also with high indexes of poverty and where most of the Afro-Colombian population resides, iv. Northwestern or “paisa” region, where there are many local traditions and there is a larger degree of European and Jewish ancestry and v. Northeastern/Andean region, mostly cold, very mountainous and with a larger degree of indigenous ancestry. Given that 81% of the Colombian population lives currently in urban centers, we undertook a study in five cities, one from each region, in order to answer the following research question: What is the prevalence of diabetes by random plasma glucose, self-report or medication use in the main urban centers of Colombia, and how does the nutrient intake of these individuals compare to that of people without diabetes? An ancillary goal of the study was to explore to what extent do people with diabetes achieve the internationally recommended dietary goals for individuals with diabetes.

Given the recent rise in obesity rates, rapid urbanization and increased life expectancy, we expected to find a diabetes prevalence greater than that estimated from prior national surveys, but still lower than that of the largest Latin American countries Brazil and Mexico.

METHODS

COPEN (Estudio Colombiano de Perfiles Nutricionales – Colombian Study of Nutritional Profiles) was a population-based, cross-sectional, multi-stage sampling survey designed to represent five cities, one from each of Colombia´s major regions: Bogotá (Central plateau), Barranquilla (Caribbean region), Cali (Pacific region), Medellin (Northwest or "paisa" region) and Bucaramanga (Northeast/Andean region). The sampling frame was obtained from the last census of the Colombian population, cartography was obtained from the national geostatistical frame developed by the Colombian National Department of Statistics (Departamento Administrativo Nacional de Estadística - DANE) and data on socioeconomic level (SEL) came from the National Superintendence of Public Services. In the first stage of sampling we selected cartographic sectors, within sectors we selected blocks (on average 8 per cartographic sector), within blocks we selected households, and within households we selected individual participants. Within each household, individuals were randomly selected employing a Kish grid. The sample was stratified by city, sex, age group and SEL. With this design and including the design effect, the complete study sample yielded an overall sampling error of 2.2%. The sampling errors for each city were respectively: Bogotá 4.0%, Medellin 5.0%, Cali 5.0%, Barranquilla 5.6% and Bucaramanga 6.8%. We excluded foreigners living in Colombia, individuals in hemodialysis or peritoneal dialysis therapy and persons with disabilities that precluded a reliable fulfillment of the study questionnaire. The complete study for COPEN was 1942 individuals, from which a random subsample of 736 non-pregnant participants aged 18 or older (representing 47.8% of all non-pregnant adults in COPEN) participated in the analyses reported in this paper. This was mainly due to cost constraints that did not allow us to perform blood tests in all 1942 COPEN participants. We selected individuals living in the household, regardless of whether they were family members or working at the household. We performed at least two attempts to interview the selected adult. If the individual selected was still not present or declined to participate, he/she was replaced by someone from the same sampling stratum in a different household.

Information was captured using a tablet device containing digital forms with proper validation rules, developed for the study. All staff in charge of data collection was extensively trained by the study Principal Investigator. A random 10% of participants were re-contacted by phone in order

to double-check the accuracy of the information provided on date of birth, sex, city of residence, marital status, job status, educational level and date of initial contact. We confirmed data on date of birth, sex, city of residence, SES, marital status job status, educational level and date of initial contact. In all variables, we had over 95% concordance with the values originally reported. All data were collected between June and November 2018. Supplemental Figure 1 summarizes the scheme of participant recruitment for the study.

Respondents and Public Involvement

Respondents and the public were not involved in the design of the study, but aggregated results will be presented to local and national authorities to inform public health policies concerning nutrition and primary prevention of diabetes.

Measurements

We collected information on sex, date of birth, SEL, marital status, educational level and employment status using a standardized questionnaire. Since diabetes incidence rises sharply at age 40 and peaks approximately at age 60 (27), age was operationalized for most analyses in three groups: 18-39, 40-59 and 60-75 years. The SEL that we employed for analyses was the one registered in DANE for that particular block. After a brief introduction about the importance of the accuracy of the measurements to be performed, we measured height and weight in all participants, and waist circumference in participants aged 18 and older. Height was measured using a portable stadiometer supported on a firm surface, taking care that the participant was barefoot, standing right and with heels and calves touching the stadiometer. Weight was measured in a solar digital scale with 100g sensitivity and 200 Kg capacity, all study scales were calibrated simultaneously the day before the study start, and every week afterwards. Waist circumference was measured by a sitting observer, directly over the participant´s skin, at the midpoint between the las rib and the anterosuperior iliac crest, using a flexible metallic measuring tape. All measurements were performed in duplicate, and if there was a between-measures discrepancy greater than 1 cm for height, 100g for weight or 1 cm for waist circumference, a third measurement was collected. For analyses we used the average of each anthropometric measure.

Socioeconomic level is classified in Colombia by the Statistics Department DANE in 6 strata according to characteristics of the residence (with stratum 1 being the lowest and stratum 6 being the highest) (28). Residential dwellings are classified according to their physical characteristics and environment. The methodology for this classification creates homogeneous strata taking as input information about land use, public utilities, access routes, topography, land valuation and property characteristics. The stratification unit is the sub-zone, corresponding generally to a block. Residential dwellings are classified in the predominant stratum of the sub-zone, as long as their characteristics do not differ ostensibly from the predominant conditions in the group. Otherwise, they are considered outliers and their stratum is assessed based on their particular characteristics. This information is very well established, updated and freely accessible for all the country. Given that sociodemographic, income and human development indicators are more similar for individuals living in strata 4 to 6 than among the other strata (28), we analyzed SEL in three groups, corresponding to strata 1-2 (low SEL), 3 (medium SEL) and 4-6 (high SEL). Marital status was classified in three categories: i. Single, ii. Married or in cohabitation and iii. Widowed or divorced. Educational level was analyzed as the highest completed level in three categories: i. Elementary or lower, ii. Secondary or technical and iii. Professional or higher. We interpreted BMI according to the cut points proposed by the World Health Organization (WHO): Underweight (BMI<18.5 Kg/m2), normal weight (BMI >=18.5 and <25 Kg/m2), overweight (BMI>=25 and <30 Kg/m2) and obesity (BMI>=30 Kg/m2). We defined abdominal obesity as a waist circumference >= 90 cm for women, and >= 94 cm for men, according to the proposed cutoffs for Latin American adults (29).

Capillary blood specimens were collected by trained staff following standardized procedures, blood glucose levels were promptly measured and registered using an Accu-Check meter. Since fasting could not be guaranteed, we considered that an individual had diabetes if he/she met one of these three conditions: 1. A capillary blood glucose level >= 200 mg/dL, 2. A self-reported prior diagnosis of diabetes or 3. Self-reported use of an oral or injectable antidiabetic medication (30).

Usual dietary intake was assessed employing a 157-item semi-quantitative food-frequency questionnaire (FFQ). The FFQ was an enhanced and adapted version of an earlier FFQ specifically designed for the Colombian population (31). In a prior validation against four independent 24-hour

dietary recalls, a shorter version of the FFQ showed a percent of classification in the same quartile of nutrient intake between 61 and 83%, and Pearson correlation coefficients between 0.51 for protein and 0.77 for carbohydrate (32). Portion sizes were established according to the reference unit most frequently consumed for each food. There were 9 possible ingestion frequencies: i. Never, ii. One to three times/month, iii. At least once/week, iv. Two to four times/week, v. Five to six times/week; vi. Once a day, vii. Two to three times a day, viii. Four to five times a day and ix. Six or more times a day. Participants were asked to make their selections based on their usual intake over the last year. FFQs were individually administered by study staff. The nutrient contribution of each food was calculated according to composition tables by the Colombian Institute for Family Welfare (Instituto Colombiano de Bienestar Familiar - ICBF), the United States Department of Agriculture and manufacturer´s information. We only had very general data on physical activity from the iPAQ (International Physical Activity Questionnaire), short form. This instrument has 7 questions on the frequency and duration of light, moderate or intense physical activity and approximate number of sitting hours (sedentary behavior), but we considered that the degree of detail in the variable did not allow for its use as a covariate for adjustment in our analyses. The COPEN protocol and COPEN field materials (in Spanish) are provided as Supplementary Material 1 and 2, respectively.

Data analysis

Prevalence of diabetes was estimated using sampling weights reflecting city, sex, age group and SEL-specific expansion factors according to the study multi-stage sampling design. We did not have any missing data points for sociodemographic factors, diabetes status and dietary intake variables. The overall diabetes prevalence, as well as the prevalence for men and women were age-adjusted using the WHO standard population as reference population (33). The univariate associations between nominal predictors and diabetes status were examined using chi-square independence tests. To test for a linear trend in the association between ordinal predictors and diabetes status, we report the p-value associated with a rank-correlation (Spearman) test between predictor and outcome. We also ran multivariable logistic models in which sex, age group, SEL and educational level were the independent variables and diabetes status was the outcome. We initially compared mean consumption of macronutrients and micronutrients of interest between individuals with or without diabetes using a one-way ANOVA, with diabetes as fixed factor. Since

a higher BMI is associated with diabetes risk and also with a higher dietary nutrient intake, linear regressions were used to estimate nutrient intakes in participants with or without diabetes adjusted for age, sex, BMI and SEL (one model per nutrient). We explored the achievement of dietary recommendations among individuals with diabetes, expressed as the percent of individuals with diabetes who met the protein (>=15% of total caloric intake [TCI]), saturated fat (SFA) (<7% of TCI), monounsaturated fat (MUFA) (>=12% of TCI) and trans fat (<1g/day) recommendations set by the by the Latin-American Diabetes Association (30) and the fiber (14 g per each 1,000 Calories) and sodium (<2300 mg/day) goals set by the American Diabetes Association (34). In order to explore factors associated with achievement of dietary goals, we also built a series of nested multivariable logistic models, in which achievement of each dietary goal was the outcome. Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model 3 had all variables in model 2 plus city, model 4 had all variables in model 3 plus BMI, and model 5 had all variables in model 4 plus diabetes status. All analyses were performed in SPSS for Windows, v.21 (Cary, NC, USA).

Ethical aspects

All participants provided written informed consent. All study procedures were performed according to the principles of the Helsinki Declaration, and to local rules and regulations as provided by Resolution 8430 of 1993 of the Colombian Ministry of Health. The study was approved by the IRB of Universidad de los Andes (Comité de Ética de la Vicerrectoría de Investigaciones), according to minute 1016 of April 27, 2018.

RESULTS

We studied 736 adults (45% men): 132 from Barranquilla, 250 from Bogotá, 86 from Bucaramanga, 126 from Cali and 142 from Medellin. Mean age was 46.1 +/- 17.6 years, about a third of participants were older than 60. Mean BMI was higher in women than men. There were similar proportions of single and married participants, while widowed or divorced individuals were the minority. There was approximately one third of the sample in each of the low, medium and high SEL categories. Only a fifth of study participants had a college or higher degree, and about a fifth had only elementary or lower education (Table 1).

Table 1. Characteristics of the study sample.

		Men n=331 n (%)	Women n=405 n (%)	Total n=736 n (%)
Age (years)	18-39	129 (39.0)	159 (39.3)	288 (39.1)
	40-59	108 (32.6)	127 (31.4)	235 (31.9)
	60-75	94 (28.4)	119 (29.4)	213 (28.9)
City	Barranquilla	66 (19.9)	66 (16.3)	132 (17.9)
	Bogotá	109 (32.9)	141 (34.8)	250 (34.0)
	Bucaramanga	38 (11.5)	48 (11.9)	86 (11.7)
	Cali	50 (15.1)	76 (18.8)	126 (17.1)
	Medellin	68 (20.5)	74 (18.3)	142 (19.3)
Marital status	Single	151 (45.6)	139 (34.3)	290 (39.4)
	Married/cohabitation	155 (46.8)	200 (49.4)	355 (48.2)
	Widowed/divorced	25 (7.6)	66 (16.3)	91 (12.4)
Educational level	Elementary or lower	66 (19.9)	90 (22.2)	156 (21.2)
	Secondary or technical	191 (57.7)	246 (58.2)	427 (58.0)
	Professional or higher	74 (22.4)	79 (19.5)	153 (20.8)
Socioeconomic level	Low	131 (39.6)	166 (41.0)	297 (40.4)
	Medium	98 (29.6)	121 (29.9)	219 (29.8)
	High	102 (30.8)	118 (29.1)	220 (29.9)
BMI	(mean +/- SD)	25.9 +/- 4.7	28.0 +/- 6,5	27.1 +/- 5,8
Abdominal obesity (n=723)	Yes	166 (51.6)	118 (29.4)	284 (39.3)
	No	156 (48.4)	283 (70.6)	445 (60.7)

Educational level refers to the highest level completed. Socioeconomic level (SEL) according to Colombia´s official Statistics Department-DANE stratification scheme, using criteria about land use, public utilities, access routes, topography, land valuation and property characteristics of the property inhabited by the household. Low SEL includes

strata 1 and 2, medium SEL includes only stratum 3, and high SEL includes strata 4, 5 and 6. Data are n (%) unless indicated otherwise .

Compared to the official population data from Colombia reported to the UN (35), the sex and marital status distribution of urban adults aged 20-75 in Colombia was similar to that of our sample. We had a mild overrepresentation of adults aged 60-75 (28.9 *versus* 14.5% in the general population). Since we only included the five major cities, we believe this may be due to better living conditions and healthcare in large metropolitan areas that cause a greater longevity in large urban centers.

The overall estimated prevalence of diabetes was 10.1% +/- 3.2% (age-adjusted 9.44 +/- 3.0%), with no significant difference between sexes (9.6% +/- 4.3% in women, 10.8% +/- 4.7% in men; p=0.43, age-adjusted 9.5% +/- 4.1% in women, 9.2% +/- 4.0% in men) (Figure 1). The prevalence was highest in Medellin (20.5% +/- 7.2%), followed by Cali (9.2% +/- 7.5%), Bogotá (8.1% +/- 5.3%), Barranquilla (8.0% +/- 7.9%) and Bucaramanga (7.4% +/- 9.9%). As expected, the prevalence of diabetes increased monotonically with age in both men and women (p for the difference among age groups and p-trend both<0.001). For age groups 18-39 and 40-59, men had a numerically higher prevalence of diabetes than women, while in the 60-75 age group the opposite was true (Figure 1). The association between educational level and diabetes prevalence was dependent on sex. Among men, prevalence went from 7.0% for those with elementary education or lower, to 13.8% for those with a professional or higher degree. On the other hand, diabetes prevalence among women decreased steadily with higher education, going from 12.5% in the elementary or lower education group, to 7.2% in the professional or higher educational level group (Figure 2, panel A). Conversely, diabetes prevalence increased with SEL, so that prevalence in the highest SEL almost doubled that of the lowest SEL (Figure 2, panel B) (p-value for the trend in diabetes prevalence with increasing socioeconomic level=0.04.).

Diabetes was more common as BMI increased, going from 8.0% in the normal/underweight category to 12.4% for obesity (p-trend <0.001). While diabetes was almost equally prevalent among normal weight men and women, it was far more common in the male sex in the overweight and obesity categories (Supplemental Figure 2, panel A). Abdominal obesity was strongly associated with diabetes. The relative increase in diabetes prevalence for individuals with

abdominal obesity vs. without it was 65% in men and 163% (2.63-fold) in women (Supplemental Figure 2, panel B).

Unexpectedly, in analyses of dietary nutrient intake, people with diabetes reported a lower consumption of virtually all the nutrients. Consequently, the mean reported daily caloric intake was significantly lower for people with diabetes. This trend was observed for carbohydrates, total lipids, protein, SFA, MUFA, and polyunsaturated fats (PUFA), trans fats, cholesterol, sodium and fiber (Table 2). The mean daily consumption of trans fats by individuals with diabetes (2.0+/-1.2 g/day) was significantly lower than in individuals without diabetes (2.4+/-1.8 g/day, p=0.005), but still much higher than the recommended limit of maximum 1g/day. Similarly, persons with diabetes reported a significantly lower intake of sodium (3840+/-1913 mg/day *versus* 5330+/-2767 mg/day, p<0.001). People with diabetes showed a trend towards lower consumption of fiber, that did not reach statistical significance (33.2+/-14.1 g/day *versus* 37.9+/-16.9 g/day, p=0.077).

The macronutrient composition of the diet showed only small variations by diabetes status. For individuals with and without diabetes, the proportions of TCI from each macronutrient were, respectively: Carbohydrates 46.8% *versus* 48.3%, proteins 15.8% *versus* 14.2%, and lipids 36.5% *versus* 36.1%. Only the slightly higher proportion of TCI from protein was statistically significant (p<0.001) (Supplemental Figure 3, panel A). In terms of fat types, there were also very slight differences according to diabetes status. The proportions of TCI coming from each type of fat in individuals with *versus* without diabetes were, respectively: 11.7% versus 11.1% for SFA, 15.9% versus 14.7% for MUFA and 8.1% versus 8.4% for PUFA (Supplemental Figure 3, panel B). The 1.8% higher TCI from MUFA in the diabetes group was statistically significant (p=0.031).

When assessing the compliance of self-reported nutrient intake with current guidelines, the proportion of people with diabetes not meeting the dietary goal for SFA was an alarming 94.4%. Goal non-achievement was similarly high for sodium (86.7%), dietary fiber (84.4%) and trans fats (80%). For protein and MUFA goals, these proportions were lower (45.6 and 16.7%, respectively).

The achievement of dietary goals was associated with demographic factors and with the presence of diabetes (Supplemental Table 1). Men were much less likely to achieve the sodium

(5.4% *versus* 11.4% in women) and fiber (8.5% versus 13.1% in women) recommendations. Participants aged 18 to 39 were less likely to meet the trans fats and sodium recommendations than their older counterparts. Achievement of the trans fats goal was lowest in Bogotá, while for sodium intake the lowest degree of achievement was found in Barranquilla (only 3.8%). Consumption of the recommended amount of dietary fiber was particularly low in Medellin (4.2%). The proportion of people from a high SEL meeting the SFA recommendation was also very low (2.3%). Despite the observed differences in mean nutrient intake between persons with or without diabetes, the degree of goal achievement was only markedly different for sodium (13.3% in diabetes *versus* 8.0 in no diabetes) and protein (54.4% in diabetes *versus* 36.4% in no diabetes).

In a mutually adjusted logistical model that included sex, age, city of residence, BMI, SEL and educational level as covariates, only age group ($p<0.001$) and city of residence ($p=0.019$) were significant predictors of diabetes status. The ORs relative to age group 18-39 were 2.12 (95% CI: 1.09-4.01) for age group 40-59 and 4.28 (95% CI: 2.24-8.19) for age group 60-75 (details of model available upon request). Despite the notorious difference in diabetes prevalence between men and women depending on SEL and educational level, the respective interaction terms were not statistically significant ($p=0.074$ for the sex*SEL interaction, $p=0.24$ for the sex*educational level interaction term). In this model, the adjusted prevalence of diabetes was significantly higher among men than women in the low SEL ($p=0.035$).

After adjusting for sex, age, SEL and BMI, the relative difference in nutrient intake between persons with versus without diabetes ranged between -2.7% for cholesterol and -24.7% for polyunsaturated fatty acids (Figure 3). After adjustment by sex, age, socioeconomic level and body-mass index, however, only the lower consumption of sodium among individuals with diabetes retained statistical significance ($p=0.013$).

Table 2. Daily intake of macronutrients, cholesterol, sodium and fiber, by diabetes diagnosis. SFA: Saturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA: Polyunsaturated fatty acids. Data are means using sampling weights+/- SD.

	Diabetes diagnosis			Univariate p-value
	No	Yes	Difference	
Calories (Cal/Kg/day)	58.5 +/- 31.2	44.1 +/- 22.4	-14.4	<0.001
Carbohydrates (g/Kg/day)	7.08 +/- 3.9	5.18 +/- 3.1	-1.90	0.002
Protein (g/Kg/day)	2.03 +/- 1.2	1.72 +/- 0.8	-0.31	0.076
Lipids (g/Kg/day)	2.35 +/- 1.4	1.79 +/- 1	-0.56	<0.001
SFA (g/Kg/day)	0.73 +/- 0.5	0.58 +/- 0.4	-0.14	0.017
MUFA (g/Kg/day)	0.96 +/- 0.6	0.79 +/- 0.4	-0.17	0.01
PUFA (g/Kg/day)	0.56 +/- 0.4	0.39 +/- 0.3	-0.17	<0.001
Trans fatty acids (mg/day)	2.4 +/- 1.8	2.0 +/- 1.2	-0.41	0.005
Cholesterol (mg/day)	702.5 +/- 494.3	647.8 +/- 442.1	-54.7	0.75
Sodium (mg/day)	5330 +/- 2767	3840 +/- 1913.2	-1490	<0.001
Fiber (g/day)	37.9 +/- 16.9	33.2 +/- 14.1	-4.72	0.077

In nested logistic models, the variables significantly associated with attainment of dietary recommendations were different for each goal in the fully adjusted model (Table 3). Despite the reported lower intake of most nutrients by participants with diabetes, diabetes status only had a significant independent association with meeting the goal for dietary protein (OR 2.03, 95%CI 1.26-3.26). Male sex showed a negative association with meeting the dietary recommendations for sodium (OR 0.45, 95%CI 0.25-0.82), MUFA (OR 0.60, 95%CI 0.41-0.87) and fiber (OR 0.58, 95%CI 0.35-0.96). On the other hand, age was positively associated with meeting the recommendations for TFA (OR 1.019 per year, 95%CI 1.007-1.031), sodium (OR 1.026 per year, 95%CI 1.008-1.044) and fiber (OR 1.036 per year, 95%CI 1.019-1.053). Participants from high SEL were more likely to meet the goals for protein (OR 2.01, 95%CI 1.38-2.93), but less likely to meet the goal for SFA (OR 0.16, 95%CI 0.06-0.42). Individuals with obesity were more likely to reach the dietary protein recommendation (OR 2.02, 95% CI 1.33-3.07). Participants from Cali or Bucaramanga were more likely to attain the TFA goal (compared to Bogota), while those from Medellin were more less likely to meet the dietary fiber goal.

Table 3. Predictors of achievement of different dietary recommendations (goals) in multivariate, mutually adjusted logistic regression models.

	Trans fat <1g/day				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	1.09 (0.75-1.57)	1.09 (0.75-1.58)	1.11 (0.76-1.62)	1.12 (0.76-1.65)	1.12 (0 .76-1.65)
Age (per year)	1.02 (1.00-1.03)	1.02 (1.01-1.03)	1.02 (1.01-1.03)	1.02 (1.01-1.03)	1.02 (1.01-1.03)
SEL (relative to low)					
Medium	-	0.62 (0.39-0.98)	0.62 (0.39-0.98)	0.61 (0.38-0.97)	0.61 (0.38-0.97)
High	-	0.66 (0.42-1.04)	0.63 (0.40-0.99)	0.65 (0.41-1.03)	0.65 (0.41-1.03)
City (relative to Bogotá)					
Medellín	-	-	0.98 (0.55-1.76)	0.97 (0.54-1.75)	0.97 (0 .54-1.76)
Cali	-	-	2.17 (1.28-3.69)	2.12 (1.25-3.62)	2.12 (1.24-3.62)
Barranquilla	-	-	1.26 (0.71-2.23)	1.16 (0.65-2.08)	1.16 (0.65-2.08)
Bucaramanga	-	-	2.50 (1.37-4.56)	2.47 (1.35-4.52)	2.47 (1.35-4.52)
BMI (relative to normal)					
Overweight	-	-	-	1.09 (0.69-1.72)	1.09 (0.69-1.72)
Obesity	-	-	-	1.20 (0.72-1.99)	1.20 (0.72-1.99)
Diabetes	-	-	-	-	0.96 (0.53-1.73)
	Sodium <2300 mg/day				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	0.45 (0.25-0.79)	0.44 (0.25-0.78)	0.45 (0.25-0.80)	0.46 (0.26-0.83)	0.45 (0.25-0.82)
Age (per year)	1.02 (1.01-1.04)	1.02 (1.01-1.04)	1.03 (1.01-1.04)	1.03 (1.01-1.05)	1.03 (1.01-1.04)
SEL (relative to low)					
Medium	-	0.78 (0.39-1.57)	0.73 (0.36-1.47)	0.74 (0.36-1.50)	0.73 (0.36-1.49)
High	-	1.62 (0.88-2.95)	1.58 (0.86-2.91)	1.56 (0.83-2.94)	1.54 (0.81-2.90)
City (relative to Bogotá)					
Medellín	-	-	0.85 (0.40-1.79)	0.80 (0.37-1.74)	0.77 (0.36-1.69)
Cali	-	-	1.08 (0.52-2.25)	1.09 (0.52-2.28)	1.07 (0.51-2.25)
Barranquilla	-	-	0.37 (0.13-1.00)	0.36 (0.13-1.00)	0.36 (0.13-1.00)
Bucaramanga	-	-	1.48 (0.67-3.26)	1.35 (0.60-3.05)	1.35 (0.60-3.06)
BMI (relative to normal)					
Overweight	-	-	-	1.21 (0.64-2.30)	1.24 (0.65-2.37)
Obesity	-	-	-	1.07 (0.51-2.22)	1.08 (0.52-2.26)
Diabetes	-	-	-	-	1.50 (0.73-3.08)
	Protein >=15% of TCI				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	1.03 (0.77-1.39)	1.02 (0.76-1.38)	1.04 (0.77-1.41)	1.15 (0.84-1.57)	1.13 (0.82-1.54)
Age (per year)	1.00 (0.99-1.01)	1.00 (0.99-1.01)	1.00 (0.99-1.01)	1.00 (0.99-1.01)	1.00 (0.99-1.01)
SEL (relative to low)					
Medium	-	1.24 (0.85-1.79)	1.22 (0.84-1.77)	1.25 (0.86-1.83)	1.25 (0.85-1.83)
High	-	1.93 (1.35-2.77)	1.94 (1.35-2.79)	2.08 (1.43-3.02)	2.01 (1.38-2.94)
City (relative to Bogotá)					
Medellín	-	-	0.88 (0.57-1.36)	0.90 (0.58-1.39)	0.83 (0.53-1.30)
Cali	-	-	1.22 (0.78-1.89)	1.12 (0.72-1.75)	1.11 (0.71-1.74)
Barranquilla	-	-	0.76 (0.48-1.19)	0.68 (0.43-1.07)	0.68 (0.43-1.09)
Bucaramanga	-	-	1.15 (0.70-1.91)	1.06 (0.63-1.77)	1.07 (0.64-1.80)
BMI (relative to normal)					
Overweight	-	-	-	1.07 (0.74-1.54)	1.09 (0.75-1.58)
Obesity	-	-	-	2.02 (1.33-3.06)	2.02 (1.33-3.07)
Diabetes	-	-	-	-	2.03 (1.26-3.26)

	SFA <7% of TCI				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	1.25 (0.73-2.14)	1.27 (0.74-2.19)	1.27 (0.74-2.2)	1.24 (0.71-2.19)	1.26 (0.71-2.22)
Age (per year)	1.01 (1.00-1.03)	1.02 (1.00-1.03)	1.02 (1.00-1.03)	1.01 (1.00-1.03)	1.02 (1.00-1.03)
SEL (relative to low)					
Medium	-	0.60 (0.33-1.10)	0.59 (0.32-1.10)	0.59 (0.32-1.10)	0.59 (0.32-1.11)
High	-	0.16 (0.06-0.42)	0.15 (0.06-0.41)	0.16 (0.06-0.41)	0.16 (0.06-0.42)
City (relative to Bogotá)					
Medellín	-	-	0.64 (0.27-1.52)	0.63 (0.25-1.55)	0.64 (0.26-1.58)
Cali	-	-	1.05 (0.48-2.29)	1.11 (0.51-2.45)	1.13 (0.51-2.49)
Barranquilla	-	-	1.19 (0.55-2.58)	1.24 (0.57-2.71)	1.22 (0.56-2.67)
Bucaramanga	-	-	1.32 (0.52-3.30)	1.25 (0.50-3.16)	1.22 (0.48-3.10)
BMI (relative to normal)					
Overweight	-	-	-	2.02 (1.03-3.94)	2.01 (1.03-3.91)
Obesity	-	-	-	0.89 (0.38-2.07)	0.91 (0.39-2.14)
Diabetes	-	-	-	-	0.55 (0.19-1.64)
	MUFA >=12% of TCI				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	0.64 (0.45-0.92)	0.63 (0.44-0.90)	0.62 (0.44-0.90)	0.61 (0.42-0.88)	0.60 (0.41-0.87)
Age (per year)	0.99 (0.98-1.00)	0.99 (0.98-1.00)	0.99 (0.98-1.00)	0.99 (0.98-1.00)	0.99 (0.98-1.00)
SEL (relative to low)					
Medium	-	1.35 (0.89-2.05)	1.35 (0.88-2.06)	1.31 (0.85-2.00)	1.30 (0.85-2.00)
High	-	2.34 (1.47-3.72)	2.46 (1.54-3.95)	2.38 (1.48-3.83)	2.32 (1.44-3.74)
City (relative to Bogotá)					
Medellín	-	-	0.67 (0.40-1.11)	0.68 (0.41-1.14)	0.66 (0.39-1.10)
Cali	-	-	0.71 (0.42-1.20)	0.71 (0.42-1.22)	0.71 (0.41-1.20)
Barranquilla	-	-	1.03 (0.59-1.82)	1.05 (0.59-1.86)	1.06 (0.60-1.88)
Bucaramanga	-	-	0.45 (0.25-0.81)	0.46 (0.26-0.83)	0.47 (0.26-0.84)
BMI (relative to normal)					
Overweight	-	-	-	0.84 (0.55-1.29)	0.86 (0.56-1.32)
Obesity	-	-	-	0.85 (0.52-1.40)	0.84 (0.51-1.38)
Diabetes	-	-	-	-	1.70 (0.91-3.19)
	Fiber >=14 g / 1000 Cal				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	0.61 (0.37-0.99)	0.61 (0.37-0.99)	0.62 (0.38-1.01)	0.58 (0.35-0.97)	0.58 (0.35-0.96)
Age (per year)	1.03 (1.02-1.05)	1.03 (1.02-1.05)	1.04 (1.02-1.05)	1.04 (1.02-1.05)	1.04 (1.02-1.05)
SEL (relative to low)					
Medium	-	1.04 (0.57-1.89)	0.94 (0.51-1.73)	0.91 (0.49-1.69)	0.91 (0.49-1.68)
High	-	1.52 (0.86-2.68)	1.53 (0.86-2.72)	1.47 (0.82-2.64)	1.46 (0.81-2.61)
City (relative to Bogotá)					
Medellín	-	-	0.21 (0.08-0.51)	0.21 (0.08-0.52)	0.21 (0.08-0.51)
Cali	-	-	0.7 (0.36-1.34)	0.72 (0.37-1.4)	0.71 (0.37-1.39)
Barranquilla	-	-	0.53 (0.26-1.07)	0.54 (0.27-1.11)	0.55 (0.27-1.11)
Bucaramanga	-	-	0.68 (0.31-1.5)	0.69 (0.31-1.53)	0.69 (0.31-1.53)
BMI (relative to normal)					
Overweight	-	-	-	1.09 (0.62-1.92)	1.09 (0.62-1.92)
Obesity	-	-	-	0.76 (0.39-1.49)	0.76 (0.38-1.48)
Diabetes	-	-	-	-	1.31 (0.67-2.56)

Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model 3 had all variables in model 2 plus BMI, model 4 had all variables in model 3 plus city, and model 5 had all variables in model 4 plus diabetes status. Data are OR (95%CI).TCI: Total caloric intake.

DISCUSSION

We performed a population-based study to describe diabetes prevalence and associated dietary nutrient ingestion patterns in five Colombian cities representing the main regions of the country. We found an overall prevalence of 10.1% based on random plasma glucose, self-reported diabetes or medication use. Diabetes was more common with older age, higher SEL, excess body weight, abdominal obesity, and among residents of Medellin. The association between diabetes prevalence and education was dependent on sex: A higher educational level was associated with a lower prevalence of diabetes among women and with a higher prevalence of diabetes among men. People with diabetes reported significantly less caloric intake than those without diabetes, a difference was also present for most macronutrients, but retained statistical significance after adjustment only in the case of dietary sodium. When compared with current guidelines, the proportion of individuals with diabetes not achieving dietary recommendations for SFA, MUFA, trans fats, fiber and sodium was remarkably high. We also found that the odds of achieving dietary recommendations were largely influenced by sex, age group, city of residence and, in the case of dietary protein, diabetes status.

The reported prevalence of diabetes in Colombia varies widely across studies and official documents, reflecting a lack of accurate population-level data, a problem common to many developing countries. The International Diabetes Federation Diabetes Atlas 2019 estimated an adjusted diabetes prevalence of 7.4% for the Colombian population (36), and the World Health Organization in its 2016 Diabetes Country Profiles reported a total prevalence of 8.0% (12). Meanwhile, the above-mentioned PURE study reported a prevalence of 11.1% for the population aged 35 to 70 from upper-middle income countries (13), much higher than the national survey done by Colombian government in 2007 (37), which found a 3.5% prevalence of self-reported diabetes in adults aged 18 to 69 (38). Results from regional studies are similarly heterogeneous. The CARMELA Study, a population-based study in large Latin American cities, found a diabetes prevalence of 8.1% in Bogotá in 2006 (39), similar to the 8.9% found in the Colombian Caribbean city of Cartagena in 2005 (40). A comparison of our findings with prior studies reveals that the diabetes epidemic seems to be progressing faster in smaller cities in Latin America. For example, diabetes prevalence in a 2006 study of adults in Bucaramanga was only 4%, while we found 7.4%

in the same city (41). We found a comparable diabetes prevalence for most of the cities except for Medellin, where we found a much larger figure. A population study undertaken in Medellin and its suburbs in 2008-2010 (42) found a prevalence of high plasma glucose (fasting plasma glucose >100 mg/dL or taking antidiabetic medication) of 19.8%, quite comparable to our 20.1% by random plasma glucose>200 mg/dL or diabetes self-report, despite the different definition. By comparison with results from both IDF and WHO estimates and from national studies, our results seem to confirm a sizable increase in the prevalence of diabetes in Colombian cities. Further studies are needed in order to identify potential genetic, demographic or cultural reasons for the high prevalence of hyperglycemia in this region of the country.

Worldwide, the prevalence and societal burden of diabetes have been increasing steadily in recent years. Diabetes has moved from being the tenth most relevant cause of disability-adjusted life years (DALYs) lost in 1990, to being the fourth in 2005, and the third in 2015 (43). The rapid expansion of the diabetes epidemic is being driven mostly by small prevalence increases in largely populated Asian countries (China and India) (44), but also by sustained prevalence increases in developed countries in Europe and North America. According to the IDF Diabetes Atlas 2019, diabetes prevalence among adults in the North America and Caribbean region was estimated at 13.3%, while in Europe it was 8.9% (36). The most recent estimate of the US Centers for Disease Control places diabetes prevalence in the USA at 13.0% (45). Thus, our estimations worryingly place the prevalence of diabetes among urban adults from Colombia at a level close to that of developed countries, and to that of Latin American countries traditionally leading diabetes prevalence statistics like Brazil (11.4%) and Mexico (15.1%) (36). Overall, our study led to an estimate of diabetes prevalence much more plausible and coherent with international projections than data from existing national health surveys.

The most important independent correlate of diabetes in our study was increasing age, as has been described for most populations worldwide (43). Our study found an estimated prevalence of diabetes among older adults remarkably close to that encountered in recent surveys from the SABE study (17.5% in SABE Bogotá, executed in 2012 (20); 18.5% in SABE Colombia, executed in 2015 (19) and 20.6% in COPEN, executed in 2018). Thus, recent data support the idea of an accelerated increase in the prevalence of diabetes among older adults in Colombia. For the most

part, the relationship between socioeconomic status and diabetes is consistent in high-income countries: a lower position increases risk (46-49). Meanwhile, the magnitude and direction of this association in middle- and low-income countries is conflicting across studies, perhaps due to imperfect data, to the use of different proxies for SEL, or to the rapid development of demographic and nutritional transitions that affect them in ways different from what takes place in the developed world (50-52). In Colombia, the higher prevalence of *diagnosed* diabetes with higher SEL may be explained at least partially by increased access to medical care and diabetes screening with higher income (53).

Prior studies had found an interaction between sex and educational level, so that more educated women had a lower prevalence of diabetes. A large multi-national study reported increasing odds of diabetes as education increased among men from middle-income countries. For women, the association was flat or slightly negative (54). Other studies of the associations between socioeconomic variables and diabetes have also found a different pattern according to sex (55,56). Studies from Mexico (57) Argentina (58) and Brazil (59) have also documented higher rates of obesity and diabetes among more educated males and less educated females. Many factors could explain these results, but one that may apply to our context is a larger degree of body dissatisfaction among women, that increases with higher education. A study in Bogotá showed that women with higher education were more likely to identify thinner body silhouettes as their preferred ones (60). Our results complement a body of evidence suggesting that education of women may be a tool in the fight against the diabetes epidemic in developing countries.

We were surprised to find a lower self-reported weight-adjusted intake of calories and all macronutrients among persons with diabetes. An optimistic interpretation of this finding would be that it shows good adherence to dietary recommendations. However, such interpretation should be made with caution, as it is known that people with diabetes and obesity frequently underreport their caloric intake (61).

The fact that the lower mean intake of all nutrients but sodium in people with diabetes lost significance after multivariate adjustment, suggests that major sociodemographic factors (older age) and a higher BMI are the main factors explaining a lower reported dietary intake in persons

with diabetes. In any event, these differences did not result in increased odds of achieving dietary recommended intakes of key nutrients, as only reaching the %TCI from protein was independently associated with diabetes status.

Despite reporting quantitatively less intake of most nutrients, the relative proportion of macronutrients from each source in participants with diabetes was remarkably similar to that of people without diabetes. This finding also applied to fat subtypes: SFA, MUFA and PUFA represented a comparable share of TCI regardless of diabetes status. This points out that individuals with diabetes (many of whom know already know about of their diabetes status), are not modifying their diets enough to intentionally increase the percent of Calories from MUFA, as well as reducing their intake of SFA and TFA. A survey of patients with type 2 diabetes from general practices in the Netherlands found a 15% mean TCI from SFA at the moment of diagnosis, which had descended to 11.9% by four years after diagnosis (62). This is still far from the recommendation of <7% TCI from SFA. Thus, excessive consumption of SFA by people with diabetes seems to be a ubiquitous problem.

The intake of dietary fiber was equally concerning, in this case because of too little consumption, a problem that was more evident in participants who were younger, male, or lived in Medellin. A meta-analysis of randomized controlled trials concluded that diets with foods rich in fiber up to 42.5 g/day reduced glycated hemoglobin by a mean 0.55% and fasting plasma glucose by 9.9 mg/dL in persons with diabetes (63). Hence, a low consumption of dietary fiber constitutes a lost opportunity for improving the health of persons with diabetes. Dietary TFA are a powerful cardiovascular risk factor, even at intakes as low as 2% of TCI. For this reason, their intake is restricted by most dietary guidelines to less than 1g/day, with special emphasis on populations at high baseline risk for cardiovascular disease, like people with diabetes or older people (64). We found that only one in every five individuals with diabetes was achieving this goal, and the odds of achieving it were significantly lower with younger age or higher SEL, probably in relation with a higher consumption of processed, industrialized foods (64). TFA intake is an independent predictor of total and cardiovascular mortality (65), so extreme efforts should be put in place in order to limit their consumption both in the general population and among persons with diabetes.

Our results bring out many areas of potential intervention for nutritional prevention, which are particularly relevant in our context. Nutritional education of people with diabetes in developing countries is an urgent measure with large potential benefits and minimal risks.

Limitations of our study include the entirely urban sample, given the recent increase in obesity in rural areas in the continent (66) and Colombia (67). It is important, however, that the proportion of total population living in urban centers is in Colombia is 77.1% (68), a result of accelerated urbanization induced by years of internal conflict that has impacted the epidemiologic profile of the country (14). Another relevant limitation was the unavailability of oral glucose tolerance test (OGTT) data, so our ascertainment of diabetes status relied on random plasma glucose measurement and diabetes self-report, which may lead to underestimation of the true disease prevalence. OGTT is the most sensitive test for diabetes diagnosis but performing it would have imposed great complexities on the logistics of the study. We acknowledge that the prevalences we report, high as they seem, are most likely an underestimation. Concerning the instrument to measure dietary intake, FFQs have the advantage of inquiring about usual (rather than recent) intake, to be more comprehensive than 24-hour dietary recalls, and not as susceptible to modification by recent diet as food diaries. They do have the limitations of tending to overestimate total Caloric intake, and of having to be adjusted for different populations. However, the problems inherent to recall bias exist for all dietary assessment tools, except for food diaries, which are seldom used in epidemiology. FFQs have been shown to successfully assess average dietary intake up to 4 years prior to their application (69). Finally, our study did not collect detailed information on lifestyle variables like smoking or physical activity, which may explain or correlate with the described dietary intakes.

In summary, our results confirm a continued progression of the diabetes epidemic in Colombia, a middle-income country, and its relationship with demographic and socioeconomic factors. We also found remarkably low rates of achievement of key nutritional goals among individuals with diabetes, and identified factors associated with their achievement. Further research focused in rural areas is needed in order to build a complete the picture of evolution of the diabetes epidemic in the developing world.

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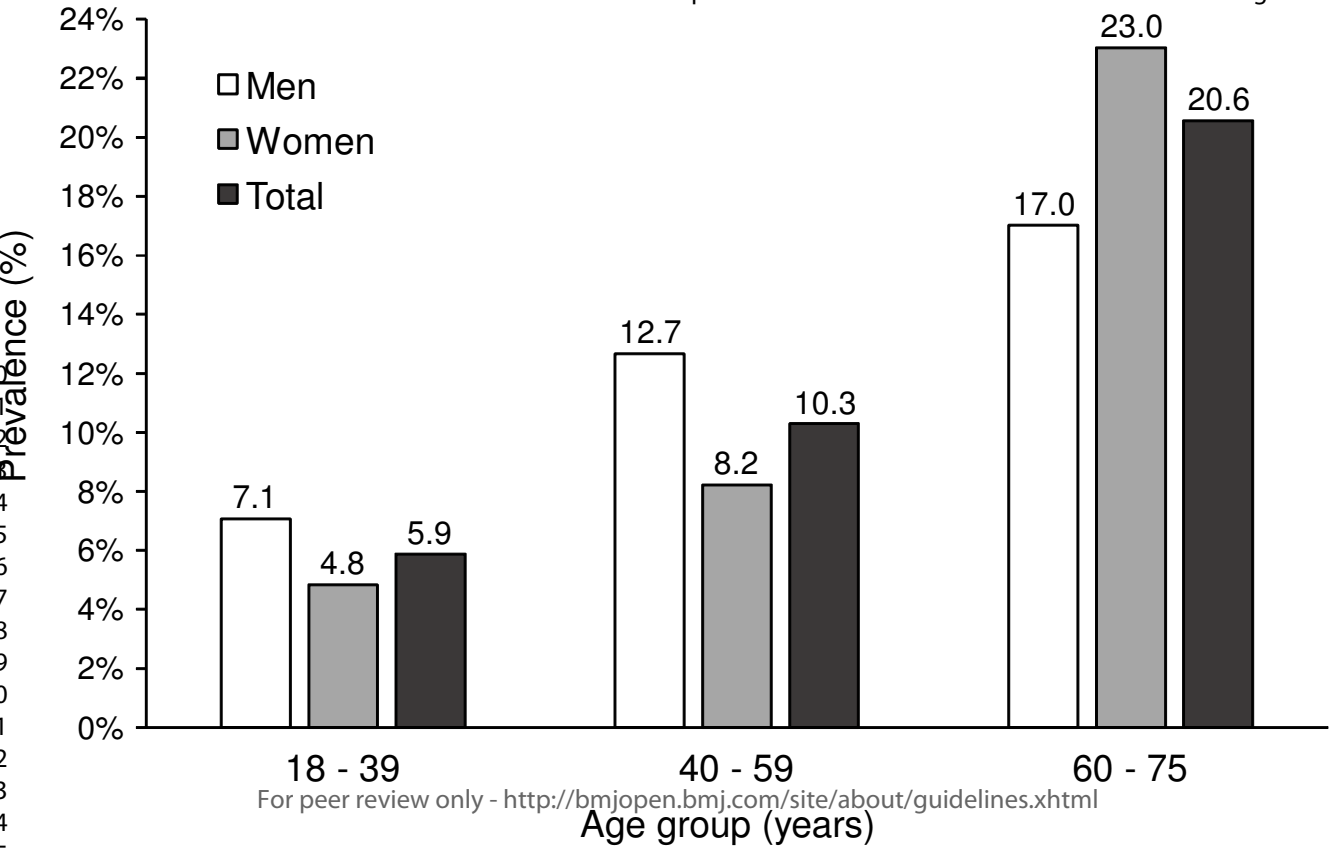
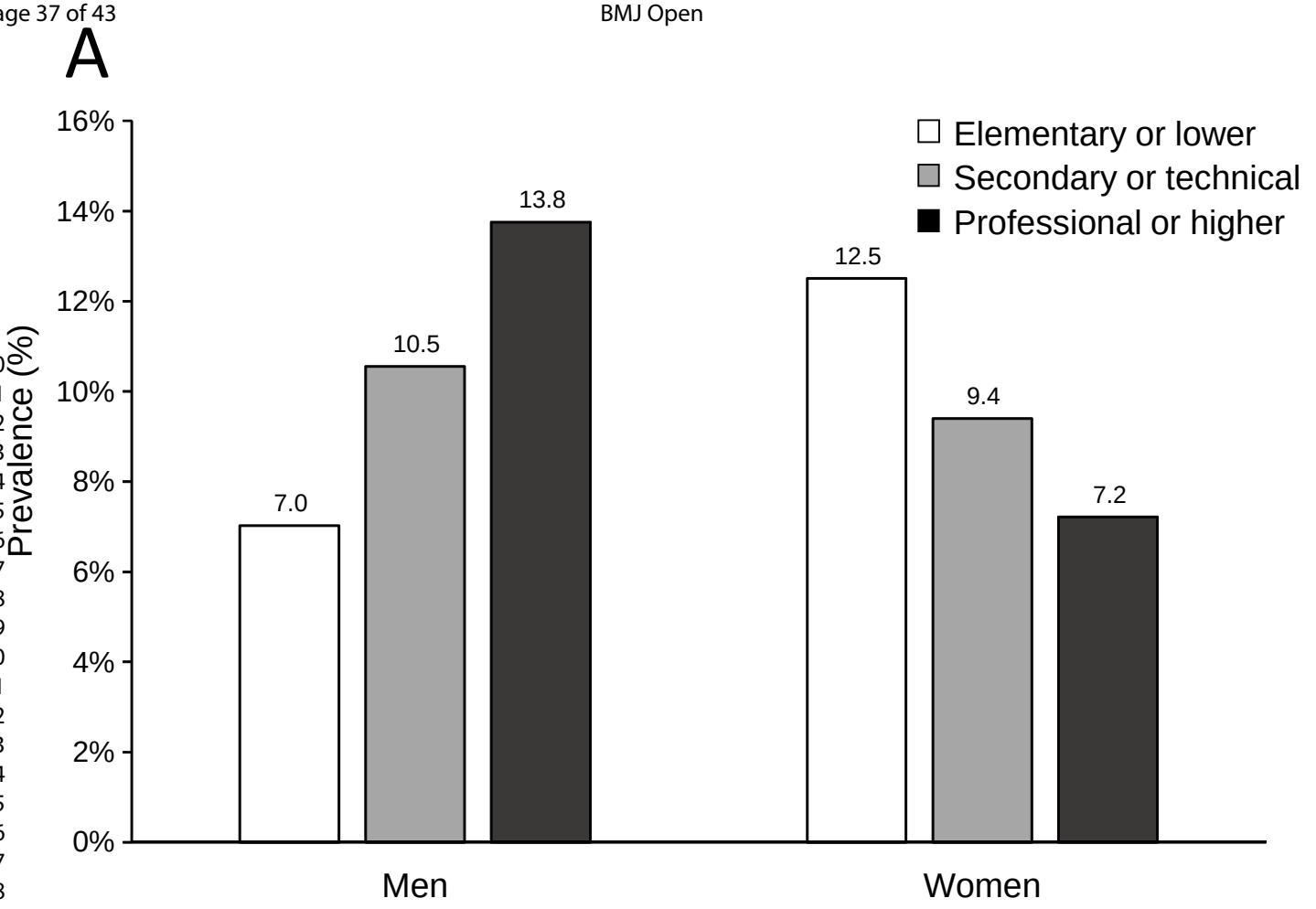
Figure legends

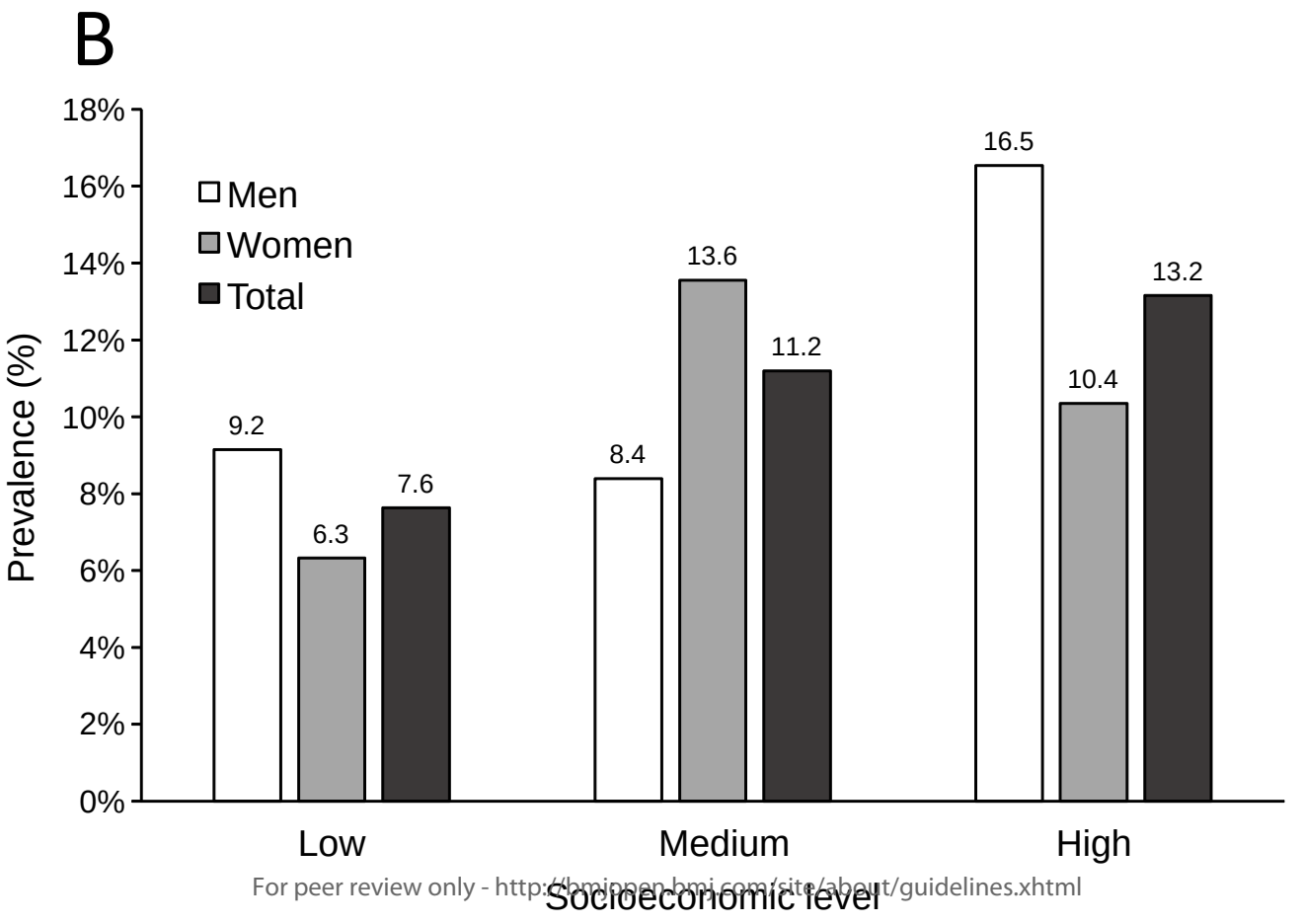
Figure 1. Prevalence of diabetes, by age and sex. Data are prevalences using sampling weights. P-value for the overall difference in prevalence among age groups <0.001. P-value for the trend in diabetes prevalence with increasing age group <0.001.

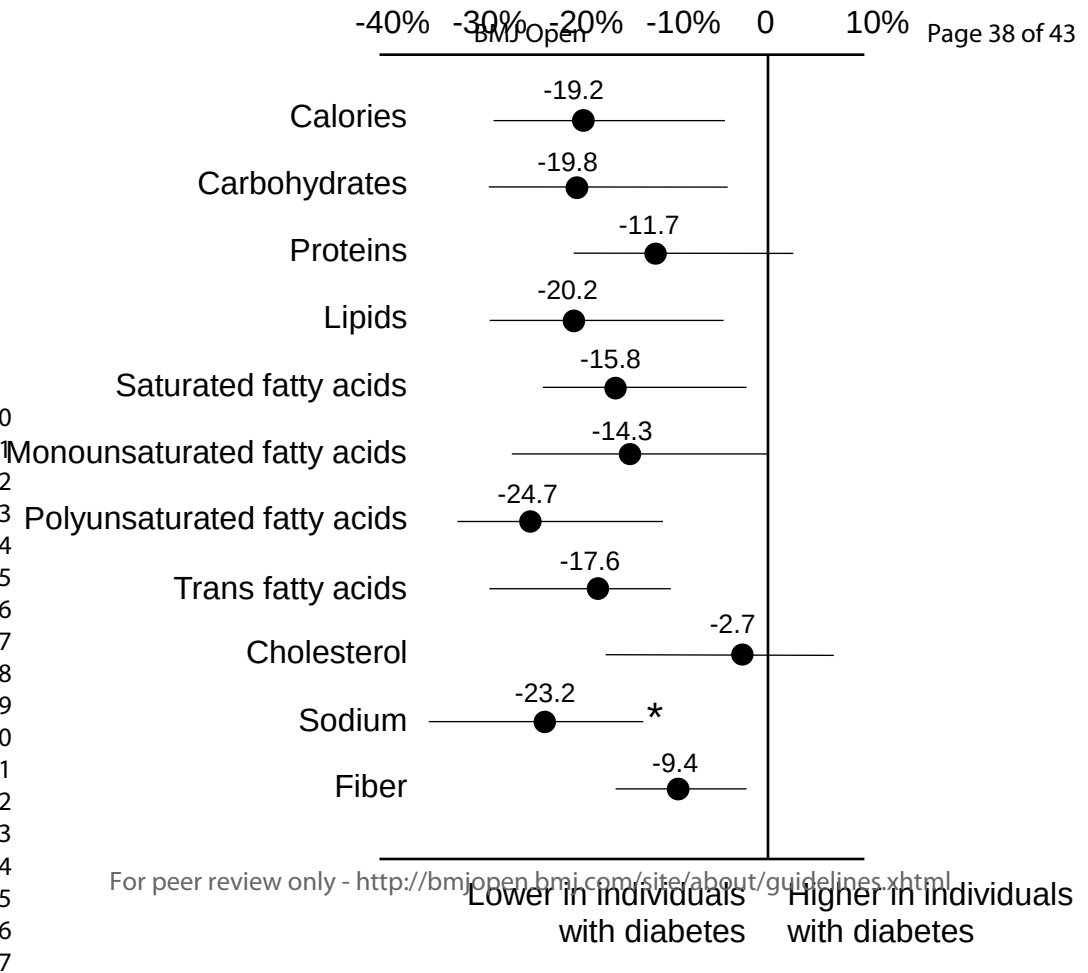
Figure 2. Prevalence of diabetes, by educational level (Panel A) and socioeconomic level (Panel B), and sex. Educational level refers to the highest level completed. Socioeconomic level (SEL) was classified according to Colombia´s official Statistics Department-DANE stratification scheme. Low SEL includes strata 1 and 2, medium SEL includes only stratum 3, and high SEL includes strata 4, 5 and 6. Data are prevalences using sampling weights. P-value for the overall difference in diabetes prevalence among socioeconomic levels=0.11. P-value for the trend in diabetes prevalence with increasing socioeconomic level=0.04.

Figure 3. Difference in adjusted nutrient intake (in g/d), between individuals with diabetes and individuals without diabetes. Dots represent medians and lines represent Q1-Q4. Differences were estimated using linear regressions including diabetes status, age, sex, BMI and SEL as predictors. *p=0.013 for the adjusted comparison of individuals with versus without diabetes.





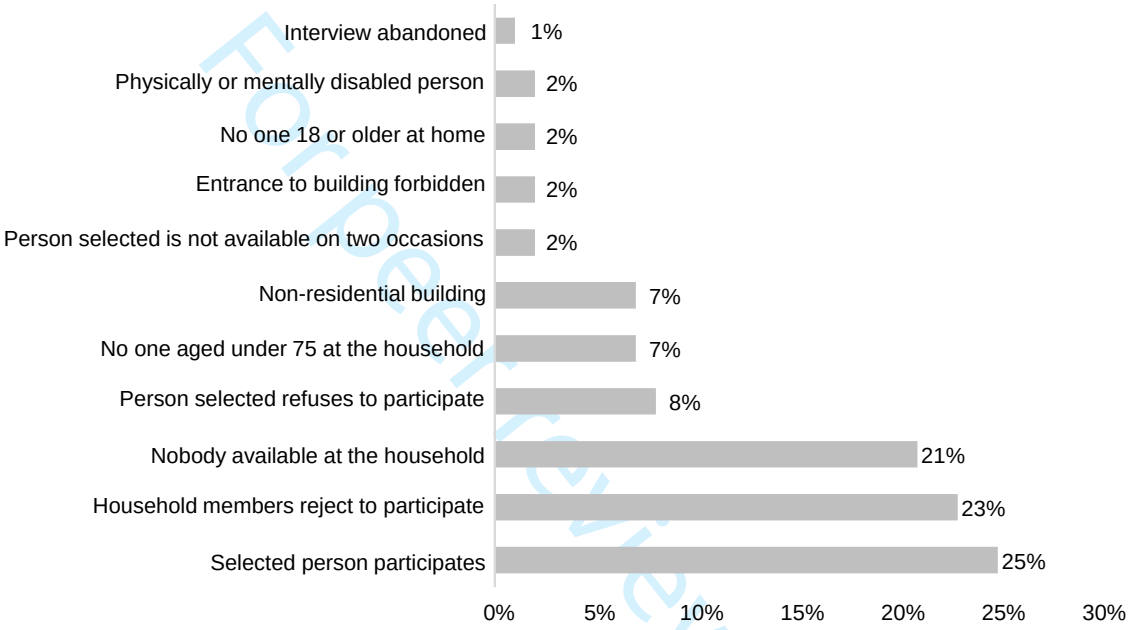




Dietary intake among urban adults with diabetes: COPEN (Colombian Nutritional Profiles), a cross-sectional study

Supplementary Material

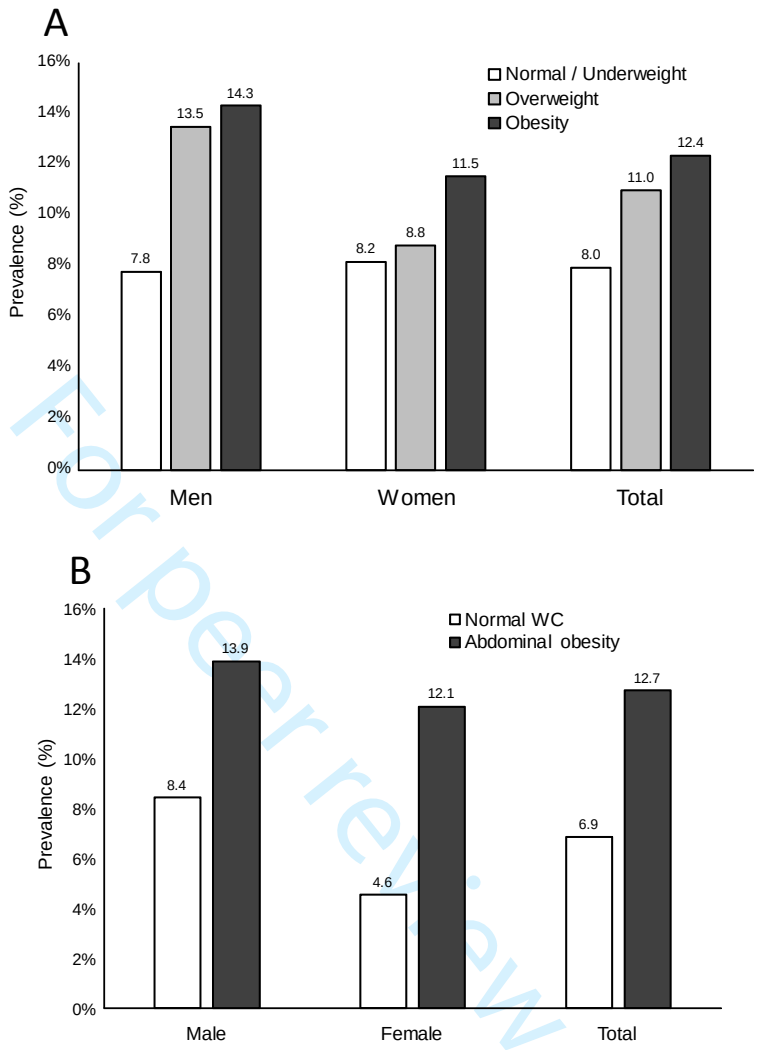
Supplemental Figure 1. Results of 7640 contacts for recruitment of study participants.



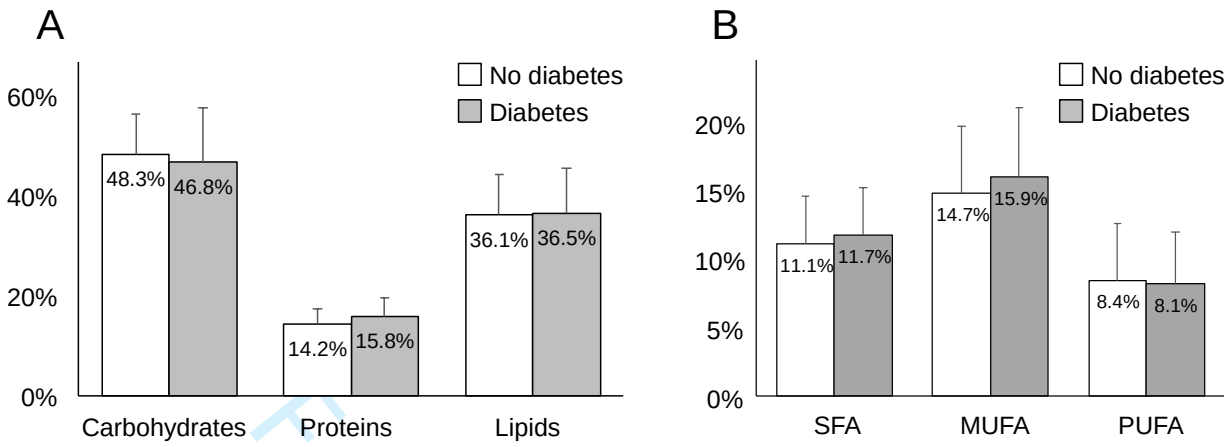
Supplemental table 1. Proportion of individuals achieving different dietary recommendations, according to sex, age group, city, SEL and educational level.

		Trans fat <1g/day	Sodium <2300 mg/day	Protein >=15% of TCI	SFA <7% of TCI	MUFA >=12% of TCI	Fiber >=14 g / 1,000 Cal
Sex	Male n=331	66 (19.9%)	18 (5.4%)	129 (39%)	29 (8.8%)	246 (74.3%)	28 (8.5%)
	Female n=405	76 (18.8%)	46 (11.4%)	155 (38.3%)	29 (7.2%)	331 (81.7%)	53 (13.1%)
Age group	18 to 39 n=288	42 (14.6%)	14 (4.9%)	103 (35.8%)	20 (6.9%)	234 (81.3%)	14 (4.9%)
	40 to 59 n=235	52 (22.1%)	30 (12.8%)	101 (43%)	14 (6%)	179 (76.2%)	33 (14%)
	60 to 75 n=213	48 (22.5%)	20 (9.4%)	80 (37.6%)	24 (11.3%)	164 (77%)	34 (16%)
City	Bogotá n=250	37 (14.8%)	23 (9.2%)	97 (38.8%)	20 (8%)	205 (82%)	39 (15.6%)
	Medellin n=142	22 (15.5%)	12 (8.5%)	51 (35.9%)	8 (5.6%)	106 (74.6%)	6 (4.2%)
	Cali n=126	35 (27.8%)	13 (10.3%)	54 (42.9%)	11 (8.7%)	96 (76.2%)	15 (11.9%)
	Barranquilla n=132	24 (18.2%)	5 (3.8%)	44 (33.3%)	12 (9.1%)	109 (82.6%)	12 (9.1%)
	Bucaramanga n=86	24 (27.9%)	11 (12.8%)	38 (44.2%)	7 (8.1%)	61 (70.9%)	9 (10.5%)
SEL	Low n=297	67 (22.6%)	22 (7.4%)	96 (32.3%)	35 (11.8%)	218 (73.4%)	26 (8.8%)
	Medium n=219	37 (16.9%)	15 (6.8%)	82 (37.4%)	18 (8.2%)	170 (77.6%)	24 (11%)
	High n=220	38 (17.3%)	27 (12.3%)	106 (48.2%)	5 (2.3%)	189 (85.9%)	31 (14.1%)
Educational level	Elementary or lower n=156	45 (28.8%)	16 (10.3%)	53 (34%)	20 (12.8%)	104 (66.7%)	16 (10.3%)
	Secondary or technical n=427	73 (17.1%)	28 (6.6%)	158 (37%)	28 (6.6%)	339 (79.4%)	47 (11%)
	Professional or higher n=153	24 (15.7%)	20 (13.1%)	73 (47.7%)	10 (6.5%)	134 (87.6%)	18 (11.8%)
Diabetes	Yes n=90	18 (20%)	12 (13.3%)	49 (54.4%)	5 (5.6%)	75 (83.3%)	14 (15.6%)
	No n=646	124 (19.2%)	52 (8%)	235 (36.4%)	53 (8.2%)	502 (77.7%)	67 (10.4%)

Data are n (%).



Supplemental Figure 2. Prevalence of diabetes, by body-mass index (Panel A) and waist circumference (Panel B) status. Underweight was defined as a body mass index (BMI) of less than 18.5 Kg/m^2, normal weight as a BMI between 18.5 and less than 25 Kg/m^2, overweight as a BMI between 25 and less than 30 Kg/m^2, and obesity as a BMI of 30 or higher. Abdominal obesity was defined as a waist circumference of 90 cm or higher in women, and 94 cm or higher in men. Data are prevalences using sampling weights.



Supplemental Figure 3. Distribution of total caloric intake (TCI) from each macronutrient (Panel A) and percent TCI from each fat type (Panel B) according to diabetes status. SFA: Saturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA: Polyunsaturated fatty acids. $p<0.001$ for the difference in percent TCI from protein, and $p=0.031$ for the difference in percent TCI from MUFA.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Page 1, line 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found Page 2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Pages 5-7
Objectives	3	State specific objectives, including any prespecified hypotheses Page 7, line 160
Methods		
Study design	4	Present key elements of study design early in the paper Page 7, line 167
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Pages 8-10
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants Page 8, lines 175-185
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Page 9, lines 200-235
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Page 9, lines 200-235
Bias	9	Describe any efforts to address potential sources of bias Page 8, lines 171-179
Study size	10	Explain how the study size was arrived at Page 8, lines 179-181
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Page 9, lines 200-235
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding Page 11, lines 259-283
		(*b*) Describe any methods used to examine subgroups and interactions Page 11, lines 267-272
		(*c*) Explain how missing data were addressed

		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy Page 11, line 259-260
		(*e*) Describe any sensitivity analyses
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Supplemental Figure 1
		(b) Give reasons for non-participation at each stage Supplemental Figure 1
		(c) Consider use of a flow diagram Supplemental Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Table 1, Page 13
		(b) Indicate number of participants with missing data for each variable of interest Not applicable
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures Page 14, lines 309-323
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included Page 14, lines 333-341
		(*b*) Report category boundaries when continuous variables were categorized Page 13, Table 1
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses Page 15, lines 355-369
Discussion		
Key results	18	Summarise key results with reference to study objectives Page 19, lines 409-422
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Page 23, lines 532-546
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Pages 19, 20, 21
Generalisability	21	Discuss the generalisability (external validity) of the study results Page 20, lines 460-473
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based Page 1, line 19

BMJ Open

Diabetes and associated dietary intake among urban adults: COPEN (Colombian Nutritional Profiles), a cross-sectional study

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Diabetes and associated dietary intake among urban adults: COPEN (Colombian Nutritional Profiles), a cross-sectional study

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ABSTRACT

Objectives: Diabetes is increasing rapidly in developing countries. We aimed to estimate the prevalence of diabetes, describe its correlates and its associated dietary intake in urban adults from Colombia.

Setting: The Colombian Study of Nutritional Profiles (COPEN) was a population-based, cross-sectional, multi-stage probabilistic sampling survey designed to represent the five main Colombian cities.

Participants: Between June and November 2018, we studied 736 non-pregnant participants aged 18 or older. Diabetes was defined as a random plasma glucose >= 200 mg/dL, self-reported prior diagnosis of diabetes or use of any oral or injectable antidiabetic medication(s). Participants also fulfilled a detailed 157-item food frequency questionnaire (FFQ).

Primary and secondary outcome measures: Prevalence of diabetes, dietary intake of key nutrients, achievement of dietary goals among individuals with diabetes.

Results: The overall estimated prevalence of diabetes was 10.1%, with no difference by sex (9.6% in women, 10.8% in men, p=0.43). The association between diabetes and education level depended on sex, diabetes was more prevalent among more educated men and less educated women. Abdominal obesity was associated with a 65% increase in diabetes prevalence among men, and a 163% increase in women. Individuals with diabetes reported lower mean consumption of all nutrients, but after adjustment by sex, age, socioeconomic level and body-mass index, only their lower sodium consumption remained significant (p=0.013). The proportion of non-achievement of dietary intake goals among participants with diabetes was 94.4% for saturated fats, 86.7% for sodium, 84.4% for fiber and 80% for trans fats. In multivariate logistic regression models, age was the strongest independent correlate of diabetes.

Conclusions

Diabetes by self-report, random plasma glucose or medication use was highly prevalent among Colombian adults. There were large differences by abdominal obesity status, region of residence,

SEL and educational level. The proportion of individuals with diabetes meeting dietary recommendations was alarmingly low.

Strengths and limitations of this study

- The study explored the prevalence of diabetes and its associated dietary nutrient intake, as well as their relationship to key demographic factors.

- The study had a population-based, probabilistic sample from five cities in Colombia.

- Dietary intake was assessed with a food frequency questionnaire adapted to national and regional dietary habits, and inquiring about usual behavior, rather than recent intake.

- Random plasma glucose and self-reported diabetes may underestimate the real diabetes prevalence compared to oral glucose tolerance tests or glycated hemoglobin measurement.

- Our study did not include any participants from rural areas, whose diabetes prevalence and associated diet may differ significantly from those of urban populations.

Data sharing statement

The study dataset and its associated variable definitions file have been publicly deposited in the dryad repository, they can be consulted under the following link:
https://doi.org/10.5061/dryad.sqv9s4n2n
All questions about these data are welcome and should be directed to corresponding author.

INTRODUCTION

The number of deaths attributed to diabetes in the year 2010 was 3.96 million, on average every eight seconds one person died from diabetes somewhere in the world (1). It is estimated that, if current trends persist, 700 million adults will live with diabetes by 2045 (2). As life expectancy increases, the number of older adults with diabetes will rise from 136 million to 276 million (2).

In South and Central America, the age-adjusted prevalence of diabetes has been estimated at 8.5% in 2019 and is expected to advance to 9.9% by 2045 (2,3). Brazil and Mexico, the most populated countries in the region, occupy respectively the fifth and sixth position in the ranking of countries with the most people with diabetes worldwide (2). The prevalence of diabetes varies widely across Latin American countries. Current data show that Puerto Rico and Mexico are the countries with the highest prevalence in the region (13.7% and 13.5% respectively), while Ecuador (5.5%) and Argentina (5.9%) have the lowest (1, 4-8). Latin America is the region where diabetes represents the largest proportion of total health expenditure (around 20% of total) (2). The cost of diabetes in Latin America and the Caribbean in 2015 was estimated at 103-142 billion dollars, a 6 to 7-fold increase relative to 2000 (9). Rapid urbanization and aging are the two main drivers of the diabetes epidemic in Latin America (10).

It is expected that, over the coming decades, the largest increase in people with diabetes will occur in countries experimenting the low to middle-income transition (1,11, 12). The Prospective Urban and Rural Epidemiology (PURE) study found that lower-income countries had the highest age and sex-adjusted prevalence of diabetes (average 12.3%), followed by upper-middle (average 11.1%,), lower-middle (average 8.7%) and high income countries (average 6.6%) (13).

Colombia is a South American country of about 48 million inhabitants, in which no recent population-based studies exploring the prevalence of diabetes or the comparative characteristics of dietary intake among individuals with diabetes are available. In Colombia, the urbanization phenomenon has been further complicated by the internal displacement of hundreds of thousands of citizens as a result a protracted internal conflict that only came to an end in the recent years (14). The estimated cost of diabetes in Colombia is the fourth largest in the region below Brazil,

Mexico and Venezuela (9). The official sources of information about the burden of diabetes in Colombia are not population-based studies, but claim databases like the High-Cost Account (*Cuenta de Alto Costo* - CAC) (15), a registry kept by an association of Colombian health insurance companies. Another frequently cited source is SISPRO (*Sistema Integrado de Información de Protección Social* - Integrated Social Protection Information System) (www.sispro.gov.co), a database that compiles all health services and procedures provided by the Colombian health system (16). These sources are useful for planning the provision of health services, but they cannot provide estimations of diabetes and its associated factors at the population level. For instance, the CAC reported a diabetes prevalence of 2.2% between July 2016 and June 2017, a figure far removed from all worldwide data in similar countries and from IDF projections (2,5,17,18). Similarly, these official sources based on care provision do not register relevant lifestyle variables, so they do not allow the exploration of dietary habits of people with diabetes in the general population. There are, however, some sources of estimates for the population prevalence of diabetes, but they are confined to a specific population group. Thus, the SABE (from the Spanish SAlud, Bienestar y Envejecimiento – Health, well-being and ageing) Colombia study found a rate of self-reported diabetes of 18.5% among adults aged over the age of 60 in 2015 (19). A similar prevalence (17.5%) was found in the SABE Bogotá survey of older adults in the country´s capital (20).

In Colombia, population-based surveys have demonstrated a notorious increase in both child and adult obesity over the last two decades (21). Such increases parallel those observed in Mexico and other Latin-American countries, suggesting that the recent phenomena of mass urbanization, westernization of dietary habits and adoption of sedentary behaviors are translating into a demographic and nutrition transition in the whole region (22). These changes have disproportionately affected more economically vulnerable segments of the population (23).

In addition to the recent rise in obesity, Colombia has also experienced a slow but sustained increase in life expectancy that started in the second half of the 20th century, especially among women (24). The combination of these factors greatly favors the development of diabetes and other chronic diseases, hence the exploration of the current of diabetes and its associated dietary behaviors is of great importance.

Dietary behavior is a crucial determinant of the degree of control and the development of chronic complications among individuals with diabetes. Dietary habits have a large impact on various parameters directly related to the risk of chronic complications, among them blood glucose levels, plasma lipids and blood pressure (25). Hence, the adequate documentation and exploration of the dietary habits of this population is of the utmost importance to guide clinical strategies and public health policies aimed at persons with diabetes. Despite the multiple combinations of macronutrients that may be adjusted to each person´s requirements and cultural preferences, most guidelines agree on a few universal goals whose attainment predicts a larger probability of diabetes control, and prevention of chronic complications (26). These goals usually comprise the distribution of calories among the different macronutrients, the restriction of dietary trans fats, sodium and cholesterol, and the provision of an adequate amount of dietary fiber. We expected that most persons with diabetes would attain these dietary goals in Colombian cities. Also, given the known association of diabetes with excess body weight and hence a net positive caloric balance, we expected caloric and nutrient intake to be higher among individuals with diabetes.

Among the Latin American nations, Colombia is characterized by a high degree of geographical, racial and cultural diversity, with five clearly defined regions: i. The urban central plateau, where the capital city of Bogota is located, ii. The northern Caribbean region, very similar to countries like Cuba or the Dominican Republic, iii. The Pacific coast, with major agricultural and industrial development but also with widespread poverty and a high proportion of Afro-Colombian population, iv. The northwestern or “paisa” region, with a higher Caucasian ancestry and a generally traditionalist population and v. The northeastern/Andean region, very mountainous and with extensive native Colombian ancestry. Given that 81% of the Colombian population lives currently in urban centers, we undertook a study in five cities, one from each region, in order to answer the following research question: What is the prevalence of diabetes by random plasma glucose, self-report or medication use in the main urban centers of Colombia, and how does the nutrient intake of these individuals compare to that of people without diabetes? An ancillary goal of the study was to explore to what extent do people with diabetes achieve the internationally recommended dietary goals for individuals with diabetes.

Given the recent rise in obesity rates, rapid urbanization and increased life expectancy, we expected to find a diabetes prevalence greater than that estimated from prior national surveys, but still lower than that of the largest Latin American countries Brazil and Mexico.

METHODS

COPEN (Estudio Colombiano de Perfiles Nutricionales – Colombian Study of Nutritional Profiles) was a population-based, cross-sectional, multi-stage sampling survey designed to represent five cities, one from each of Colombia´s major regions: Bogotá (Central plateau), Barranquilla (Caribbean region), Cali (Pacific region), Medellin (Northwest or "paisa" region) and Bucaramanga (Northeast/Andean region). The sampling frame was obtained from the last census of the Colombian population, cartography was obtained from the national geostatistical frame developed by the Colombian National Department of Statistics (Departamento Administrativo Nacional de Estadística - DANE) and data on socioeconomic level (SEL) came from the National Superintendence of Public Services. In the first stage of sampling we selected cartographic sectors, within sectors we selected blocks (on average 8 per cartographic sector), within blocks we selected households, and within households we selected individual participants. Within each household, individuals were randomly selected employing a Kish grid. The sample was stratified by city, sex, age group and SEL. With this design and including the design effect, the complete study sample yielded an overall sampling error of 2.2%. The sampling errors for each city were respectively: Bogotá 4.0%, Medellin 5.0%, Cali 5.0%, Barranquilla 5.6% and Bucaramanga 6.8%. We excluded foreigners living in Colombia, individuals in hemodialysis or peritoneal dialysis therapy and persons with disabilities that precluded a reliable fulfillment of the study questionnaire. The complete study for COPEN was 1942 individuals, from which a random subsample of 736 non-pregnant participants aged 18 or older (representing 47.8% of all non-pregnant adults in COPEN) participated in the analyses reported in this paper. This was mainly due to cost constraints that did not allow us to perform blood tests in all 1942 COPEN participants. We selected individuals living in the household, regardless of whether they were family members or working at the household. We performed at least two attempts to interview the selected adult. If the individual selected was still not present or declined to participate, he/she was replaced by someone from the same sampling stratum in a different household.

Information was captured using a tablet device containing digital forms with proper validation rules, developed for the study. All staff in charge of data collection was extensively trained by the study Principal Investigator. A random 10% of participants were re-contacted by phone in order

to double-check the accuracy of the information provided on date of birth, sex, city of residence, marital status, job status, educational level and date of initial contact. We confirmed data on date of birth, sex, city of residence, SES, marital status job status, educational level and date of initial contact. In all variables, we had over 95% concordance with the values originally reported. All data were collected between June and November 2018. Supplemental Figure 1 summarizes the scheme of participant recruitment for the study.

Patients and public involvement

Respondents and the public were not involved in the design of the study, but aggregated results will be presented to local and national authorities to inform public health policies concerning nutrition and primary prevention of diabetes.

Measurements

We collected information on sex, date of birth, SEL, marital status, educational level and employment status using a standardized questionnaire. Since diabetes incidence rises sharply at age 40 and peaks approximately at age 60 (27), age was operationalized for most analyses in three groups: 18-39, 40-59 and 60-75 years. The SEL that we employed for analyses was the one registered in DANE for that particular block. After a brief introduction about the importance of the accuracy of the measurements to be performed, we measured height and weight in all participants, and waist circumference in participants aged 18 and older. Height was measured using a portable stadiometer supported on a firm surface, taking care that the participant was barefoot, standing right and with heels and calves touching the stadiometer. Weight was measured in a solar digital scale with 100g sensitivity and 200 Kg capacity, all study scales were calibrated simultaneously the day before the study start, and every week afterwards. Waist circumference was measured by a sitting observer, directly over the participant´s skin, at the midpoint between the las rib and the anterosuperior iliac crest, using a flexible metallic measuring tape. All measurements were performed in duplicate, and if there was a between-measures discrepancy greater than 1 cm for height, 100g for weight or 1 cm for waist circumference, a third measurement was collected. For analyses we used the average of each anthropometric measure.

Socioeconomic level is classified in Colombia by the Statistics Department DANE in 6 strata according to characteristics of the residence (with stratum 1 being the lowest and stratum 6 being the highest) (28). Residential dwellings are classified according to their physical characteristics and environment. The methodology for this classification creates homogeneous strata taking as input information about land use, public utilities, access routes, topography, land valuation and property characteristics. The stratification unit is the sub-zone, corresponding generally to a block. Residential dwellings are classified in the predominant stratum of the sub-zone, as long as their characteristics do not differ ostensibly from the predominant conditions in the group. Otherwise, they are considered outliers and their stratum is assessed based on their particular characteristics. This information is very well established, updated and freely accessible for all the country. Given that sociodemographic, income and human development indicators are more similar for individuals living in strata 4 to 6 than among the other strata (28), we analyzed SEL in three groups, corresponding to strata 1-2 (low SEL), 3 (medium SEL) and 4-6 (high SEL). Marital status was classified in three categories: i. Single, ii. Married or in cohabitation and iii. Widowed or divorced. Educational level was analyzed as the highest completed level in three categories: i. Elementary or lower, ii. Secondary or technical and iii. Professional or higher. We interpreted BMI according to the cut points proposed by the World Health Organization (WHO): Underweight (BMI<18.5 Kg/m2), normal weight (BMI >=18.5 and <25 Kg/m2), overweight (BMI>=25 and <30 Kg/m2) and obesity (BMI>=30 Kg/m2). We defined abdominal obesity as a waist circumference >= 90 cm for women, and >= 94 cm for men, according to the proposed cutoffs for Latin American adults (29).

Capillary blood specimens were collected by trained staff following standardized procedures, blood glucose levels were promptly measured and registered using an Accu-Check meter. Since fasting could not be guaranteed, we considered that an individual had diabetes if he/she met one of these three conditions: 1. A capillary blood glucose level >= 200 mg/dL, 2. A self-reported prior diagnosis of diabetes or 3. Self-reported use of an oral or injectable antidiabetic medication (30).

Usual dietary intake was assessed employing a 157-item semi-quantitative food-frequency questionnaire (FFQ). The FFQ was an enhanced and adapted version of an earlier FFQ specifically designed for the Colombian population (31). In a prior validation against four independent 24-hour

dietary recalls, a shorter version of the FFQ showed a percent of classification in the same quartile of nutrient intake between 61 and 83%, and Pearson correlation coefficients between 0.51 for protein and 0.77 for carbohydrate (32). Portion sizes were established according to the reference unit most frequently consumed for each food. There were 9 possible ingestion frequencies: i. Never, ii. One to three times/month, iii. At least once/week, iv. Two to four times/week, v. Five to six times/week; vi. Once a day, vii. Two to three times a day, viii. Four to five times a day and ix. Six or more times a day. Participants were asked to make their selections based on their usual intake over the last year. FFQs were individually administered by study staff. The nutrient contribution of each food was calculated according to composition tables by the Colombian Institute for Family Welfare (Instituto Colombiano de Bienestar Familiar - ICBF), the United States Department of Agriculture and manufacturer´s information. We only had very general data on physical activity from the iPAQ (International Physical Activity Questionnaire), short form. This instrument has 7 questions on the frequency and duration of light, moderate or intense physical activity and approximate number of sitting hours (sedentary behavior), but we considered that the degree of detail in the variable did not allow for its use as a covariate for adjustment in our analyses. The COPEN protocol and COPEN field materials (in Spanish) are provided as Supplementary Material 1 and 2, respectively.

Data analysis

Prevalence of diabetes was estimated using sampling weights reflecting city, sex, age group and SEL-specific expansion factors according to the study multi-stage sampling design. We did not have any missing data points for sociodemographic factors, diabetes status and dietary intake variables. The overall diabetes prevalence, as well as the prevalence for men and women were age-adjusted using the WHO standard population as reference population (33). The univariate associations between nominal predictors and diabetes status were examined using chi-square independence tests. To test for a linear trend in the association between ordinal predictors and diabetes status, we report the p-value associated with a rank-correlation (Spearman) test between predictor and outcome. We also ran multivariable logistic models in which sex, age group, SEL and educational level were the independent variables and diabetes status was the outcome. We initially compared mean consumption of macronutrients and micronutrients of interest between individuals with or without diabetes using a one-way ANOVA, with diabetes as fixed factor. Since

a higher BMI is associated with diabetes risk and also with a higher dietary nutrient intake, linear regressions were used to estimate nutrient intakes in participants with or without diabetes adjusted for age, sex, BMI and SEL (one model per nutrient). We explored the achievement of dietary recommendations among individuals with diabetes, expressed as the percent of individuals with diabetes who met the protein (>=15% of total caloric intake [TCI]), saturated fat (SFA) (<7% of TCI), monounsaturated fat (MUFA) (>=12% of TCI) and trans fat (<1g/day) recommendations set by the by the Latin-American Diabetes Association (30) and the fiber (14 g per each 1,000 Calories) and sodium (<2300 mg/day) goals set by the American Diabetes Association (34). In order to explore factors associated with achievement of dietary goals, we also built a series of nested multivariable logistic models, in which achievement of each dietary goal was the outcome. Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model 3 had all variables in model 2 plus city, model 4 had all variables in model 3 plus BMI, and model 5 had all variables in model 4 plus diabetes status. All analyses were performed in SPSS for Windows, v.21 (Cary, NC, USA).

Ethical aspects

All participants provided written informed consent. All study procedures were performed according to the principles of the Helsinki Declaration, and to local rules and regulations as provided by Resolution 8430 of 1993 of the Colombian Ministry of Health. The study was approved by the IRB of Universidad de los Andes (Comité de Ética de la Vicerrectoría de Investigaciones), according to minute 1016 of April 27, 2018.

RESULTS

We studied 736 adults (45% men): 132 from Barranquilla, 250 from Bogotá, 86 from Bucaramanga, 126 from Cali and 142 from Medellin. Mean age was 46.1 +/- 17.6 years, about a third of participants were older than 60. Mean BMI was higher in women than men. There were similar proportions of single and married participants, while widowed or divorced individuals were the minority. There was approximately one third of the sample in each of the low, medium and high SEL categories. Only a fifth of study participants had a college or higher degree, and about a fifth had only elementary or lower education (Table 1).

Table 1. Characteristics of the study sample.

		Men n=331 n (%)	Women n=405 n (%)	Total n=736 n (%)
Age (years)	18-39	129 (39.0)	159 (39.3)	288 (39.1)
	40-59	108 (32.6)	127 (31.4)	235 (31.9)
	60-75	94 (28.4)	119 (29.4)	213 (28.9)
City	Barranquilla	66 (19.9)	66 (16.3)	132 (17.9)
	Bogotá	109 (32.9)	141 (34.8)	250 (34.0)
	Bucaramanga	38 (11.5)	48 (11.9)	86 (11.7)
	Cali	50 (15.1)	76 (18.8)	126 (17.1)
	Medellin	68 (20.5)	74 (18.3)	142 (19.3)
Marital status	Single	151 (45.6)	139 (34.3)	290 (39.4)
	Married/cohabitation	155 (46.8)	200 (49.4)	355 (48.2)
	Widowed/divorced	25 (7.6)	66 (16.3)	91 (12.4)
Educational level	Elementary or lower	66 (19.9)	90 (22.2)	156 (21.2)
	Secondary or technical	191 (57.7)	246 (58.2)	427 (58.0)
	Professional or higher	74 (22.4)	79 (19.5)	153 (20.8)
Socioeconomic level	Low	131 (39.6)	166 (41.0)	297 (40.4)
	Medium	98 (29.6)	121 (29.9)	219 (29.8)
	High	102 (30.8)	118 (29.1)	220 (29.9)
BMI	(mean +/- SD)	25.9 +/- 4.7	28.0 +/- 6,5	27.1 +/- 5,8
Abdominal obesity (n=723)	Yes	166 (51.6)	118 (29.4)	284 (39.3)
	No	156 (48.4)	283 (70.6)	445 (60.7)

Educational level refers to the highest level completed. Socioeconomic level (SEL) according to Colombia´s official Statistics Department-DANE stratification scheme, using criteria about land use, public utilities, access routes, topography, land valuation and property characteristics of the property inhabited by the household. Low SEL includes

strata 1 and 2, medium SEL includes only stratum 3, and high SEL includes strata 4, 5 and 6. Data are n (%) unless indicated otherwise .

Compared to the official population data from Colombia reported to the UN (35), the sex and marital status distribution of urban adults aged 20-75 in Colombia was similar to that of our sample. We had a mild overrepresentation of adults aged 60-75 (28.9 *versus* 14.5% in the general population). Since we only included the five major cities, we believe this may be due to better living conditions and healthcare in large metropolitan areas that cause a greater longevity in large urban centers.

The overall estimated prevalence of diabetes was 10.1% +/- 3.2% (age-adjusted 9.44 +/- 3.0%), with no significant difference between sexes (9.6% +/- 4.3% in women, 10.8% +/- 4.7% in men; p=0.43, age-adjusted 9.5% +/- 4.1% in women, 9.2% +/- 4.0% in men) (Figure 1). The prevalence was highest in Medellin (20.5% +/- 7.2%), followed by Cali (9.2% +/- 7.5%), Bogotá (8.1% +/- 5.3%), Barranquilla (8.0% +/- 7.9%) and Bucaramanga (7.4% +/- 9.9%). As expected, the prevalence of diabetes increased monotonically with age in both men and women (p for the difference among age groups and p-trend both<0.001). For age groups 18-39 and 40-59, men had a numerically higher prevalence of diabetes than women, while in the 60-75 age group the opposite was true (Figure 1). The association between educational level and diabetes prevalence was dependent on sex. Among men, prevalence went from 7.0% for those with elementary education or lower, to 13.8% for those with a professional or higher degree. On the other hand, diabetes prevalence among women decreased steadily with higher education, going from 12.5% in the elementary or lower education group, to 7.2% in the professional or higher educational level group (Figure 2, panel A). Conversely, diabetes prevalence increased with SEL, so that prevalence in the highest SEL almost doubled that of the lowest SEL (Figure 2, panel B) (p-value for the trend in diabetes prevalence with increasing socioeconomic level=0.04.).

Diabetes was more common as BMI increased, going from 8.0% in the normal/underweight category to 12.4% for obesity (p-trend <0.001). While diabetes was almost equally prevalent among normal weight men and women, it was far more common in the male sex in the overweight and obesity categories (Supplemental Figure 2, panel A). Abdominal obesity was strongly associated with diabetes. The relative increase in diabetes prevalence for individuals with

abdominal obesity vs. without it was 65% in men and 163% (2.63-fold) in women (Supplemental Figure 2, panel B).

Unexpectedly, in analyses of dietary nutrient intake, people with diabetes reported a lower consumption of virtually all the nutrients. Consequently, the mean reported daily caloric intake was significantly lower for people with diabetes. This trend was observed for carbohydrates, total lipids, protein, SFA, MUFA, and polyunsaturated fats (PUFA), trans fats, cholesterol, sodium and fiber (Table 2). The mean daily consumption of trans fats by individuals with diabetes (2.0+/-1.2 g/day) was significantly lower than in individuals without diabetes (2.4+/-1.8 g/day, p=0.005), but still much higher than the recommended limit of maximum 1g/day. Similarly, persons with diabetes reported a significantly lower intake of sodium (3840+/-1913 mg/day *versus* 5330+/-2767 mg/day, p<0.001). People with diabetes showed a trend towards lower consumption of fiber, that did not reach statistical significance (33.2+/-14.1 g/day *versus* 37.9+/-16.9 g/day, p=0.077).

The macronutrient composition of the diet showed only small variations by diabetes status. For individuals with and without diabetes, the proportions of TCI from each macronutrient were, respectively: Carbohydrates 46.8% *versus* 48.3%, proteins 15.8% *versus* 14.2%, and lipids 36.5% *versus* 36.1%. Only the slightly higher proportion of TCI from protein was statistically significant (p<0.001) (Supplemental Figure 3, panel A). In terms of fat types, there were also very slight differences according to diabetes status. The proportions of TCI coming from each type of fat in individuals with *versus* without diabetes were, respectively: 11.7% versus 11.1% for SFA, 15.9% versus 14.7% for MUFA and 8.1% versus 8.4% for PUFA (Supplemental Figure 3, panel B). The 1.8% higher TCI from MUFA in the diabetes group was statistically significant (p=0.031).

When assessing the compliance of self-reported nutrient intake with current guidelines, the proportion of people with diabetes not meeting the dietary goal for SFA was an alarming 94.4%. Goal non-achievement was similarly high for sodium (86.7%), dietary fiber (84.4%) and trans fats (80%). For protein and MUFA goals, these proportions were lower (45.6 and 16.7%, respectively).

The achievement of dietary goals was associated with demographic factors and with the presence of diabetes (Supplemental Table 1). Men were much less likely to achieve the sodium

(5.4% *versus* 11.4% in women) and fiber (8.5% versus 13.1% in women) recommendations. Participants aged 18 to 39 were less likely to meet the trans fats and sodium recommendations than their older counterparts. Achievement of the trans fats goal was lowest in Bogotá, while for sodium intake the lowest degree of achievement was found in Barranquilla (only 3.8%). Consumption of the recommended amount of dietary fiber was particularly low in Medellin (4.2%). The proportion of people from a high SEL meeting the SFA recommendation was also very low (2.3%). Despite the observed differences in mean nutrient intake between persons with or without diabetes, the degree of goal achievement was only markedly different for sodium (13.3% in diabetes *versus* 8.0 in no diabetes) and protein (54.4% in diabetes *versus* 36.4% in no diabetes).

In a mutually adjusted logistical model that included sex, age, city of residence, BMI, SEL and educational level as covariates, only age group ($p<0.001$) and city of residence ($p=0.019$) were significant predictors of diabetes status. The ORs relative to age group 18-39 were 2.12 (95% CI: 1.09-4.01) for age group 40-59 and 4.28 (95% CI: 2.24-8.19) for age group 60-75 (details of model available upon request). Despite the notorious difference in diabetes prevalence between men and women depending on SEL and educational level, the respective interaction terms were not statistically significant ($p=0.074$ for the sex*SEL interaction, $p=0.24$ for the sex*educational level interaction term). In this model, the adjusted prevalence of diabetes was significantly higher among men than women in the low SEL ($p=0.035$).

After adjusting for sex, age, SEL and BMI, the relative difference in nutrient intake between persons with versus without diabetes ranged between -2.7% for cholesterol and -24.7% for polyunsaturated fatty acids (Figure 3). After adjustment by sex, age, socioeconomic level and body-mass index, however, only the lower consumption of sodium among individuals with diabetes retained statistical significance ($p=0.013$).

Table 2. Daily intake of macronutrients, cholesterol, sodium and fiber, by diabetes diagnosis. SFA: Saturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA: Polyunsaturated fatty acids. Data are means using sampling weights+/- SD.

	Diabetes diagnosis			Univariate p-value
	No	Yes	Difference	
Calories (Cal/Kg/day)	58.5 +/- 31.2	44.1 +/- 22.4	-14.4	<0.001
Carbohydrates (g/Kg/day)	7.08 +/- 3.9	5.18 +/- 3.1	-1.90	0.002
Protein (g/Kg/day)	2.03 +/- 1.2	1.72 +/- 0.8	-0.31	0.076
Lipids (g/Kg/day)	2.35 +/- 1.4	1.79 +/- 1	-0.56	<0.001
SFA (g/Kg/day)	0.73 +/- 0.5	0.58 +/- 0.4	-0.14	0.017
MUFA (g/Kg/day)	0.96 +/- 0.6	0.79 +/- 0.4	-0.17	0.01
PUFA (g/Kg/day)	0.56 +/- 0.4	0.39 +/- 0.3	-0.17	<0.001
Trans fatty acids (mg/day)	2.4 +/- 1.8	2.0 +/- 1.2	-0.41	0.005
Cholesterol (mg/day)	702.5 +/- 494.3	647.8 +/- 442.1	-54.7	0.75
Sodium (mg/day)	5330 +/- 2767	3840 +/- 1913.2	-1490	<0.001
Fiber (g/day)	37.9 +/- 16.9	33.2 +/- 14.1	-4.72	0.077

In nested logistic models, the variables significantly associated with attainment of dietary recommendations were different for each goal in the fully adjusted model (Table 3). Despite the reported lower intake of most nutrients by participants with diabetes, diabetes status only had a significant independent association with meeting the goal for dietary protein (OR 2.03, 95%CI 1.26-3.26). Male sex showed a negative association with meeting the dietary recommendations for sodium (OR 0.45, 95%CI 0.25-0.82), MUFA (OR 0.60, 95%CI 0.41-0.87) and fiber (OR 0.58, 95%CI 0.35-0.96). On the other hand, age was positively associated with meeting the recommendations for TFA (OR 1.019 per year, 95%CI 1.007-1.031), sodium (OR 1.026 per year, 95%CI 1.008-1.044) and fiber (OR 1.036 per year, 95%CI 1.019-1.053). Participants from high SEL were more likely to meet the goals for protein (OR 2.01, 95%CI 1.38-2.93), but less likely to meet the goal for SFA (OR 0.16, 95%CI 0.06-0.42). Individuals with obesity were more likely to reach the dietary protein recommendation (OR 2.02, 95% CI 1.33-3.07). Participants from Cali or Bucaramanga were more likely to attain the TFA goal (compared to Bogota), while those from Medellin were more less likely to meet the dietary fiber goal.

Table 3. Predictors of achievement of different dietary recommendations (goals) in multivariate, mutually adjusted logistic regression models.

	Trans fat <1g/day				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	1.09 (0.75-1.57)	1.09 (0.75-1.58)	1.11 (0.76-1.62)	1.12 (0.76-1.65)	1.12 (0 .76-1.65)
Age (per year)	1.02 (1.00-1.03)	1.02 (1.01-1.03)	1.02 (1.01-1.03)	1.02 (1.01-1.03)	1.02 (1.01-1.03)
SEL (relative to low)					
Medium	-	0.62 (0.39-0.98)	0.62 (0.39-0.98)	0.61 (0.38-0.97)	0.61 (0.38-0.97)
High	-	0.66 (0.42-1.04)	0.63 (0.40-0.99)	0.65 (0.41-1.03)	0.65 (0.41-1.03)
City (relative to Bogotá)					
Medellín	-	-	0.98 (0.55-1.76)	0.97 (0.54-1.75)	0.97 (0 .54-1.76)
Cali	-	-	2.17 (1.28-3.69)	2.12 (1.25-3.62)	2.12 (1.24-3.62)
Barranquilla	-	-	1.26 (0.71-2.23)	1.16 (0.65-2.08)	1.16 (0.65-2.08)
Bucaramanga	-	-	2.50 (1.37-4.56)	2.47 (1.35-4.52)	2.47 (1.35-4.52)
BMI (relative to normal)					
Overweight	-	-	-	1.09 (0.69-1.72)	1.09 (0.69-1.72)
Obesity	-	-	-	1.20 (0.72-1.99)	1.20 (0.72-1.99)
Diabetes	-	-	-	-	0.96 (0.53-1.73)
	Sodium <2300 mg/day				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	0.45 (0.25-0.79)	0.44 (0.25-0.78)	0.45 (0.25-0.80)	0.46 (0.26-0.83)	0.45 (0.25-0.82)
Age (per year)	1.02 (1.01-1.04)	1.02 (1.01-1.04)	1.03 (1.01-1.04)	1.03 (1.01-1.05)	1.03 (1.01-1.04)
SEL (relative to low)					
Medium	-	0.78 (0.39-1.57)	0.73 (0.36-1.47)	0.74 (0.36-1.50)	0.73 (0.36-1.49)
High	-	1.62 (0.88-2.95)	1.58 (0.86-2.91)	1.56 (0.83-2.94)	1.54 (0.81-2.90)
City (relative to Bogotá)					
Medellín	-	-	0.85 (0.40-1.79)	0.80 (0.37-1.74)	0.77 (0.36-1.69)
Cali	-	-	1.08 (0.52-2.25)	1.09 (0.52-2.28)	1.07 (0.51-2.25)
Barranquilla	-	-	0.37 (0.13-1.00)	0.36 (0.13-1.00)	0.36 (0.13-1.00)
Bucaramanga	-	-	1.48 (0.67-3.26)	1.35 (0.60-3.05)	1.35 (0.60-3.06)
BMI (relative to normal)					
Overweight	-	-	-	1.21 (0.64-2.30)	1.24 (0.65-2.37)
Obesity	-	-	-	1.07 (0.51-2.22)	1.08 (0.52-2.26)
Diabetes	-	-	-	-	1.50 (0.73-3.08)
	Protein >=15% of TCI				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	1.03 (0.77-1.39)	1.02 (0.76-1.38)	1.04 (0.77-1.41)	1.15 (0.84-1.57)	1.13 (0.82-1.54)
Age (per year)	1.00 (0.99-1.01)	1.00 (0.99-1.01)	1.00 (0.99-1.01)	1.00 (0.99-1.01)	1.00 (0.99-1.01)
SEL (relative to low)					
Medium	-	1.24 (0.85-1.79)	1.22 (0.84-1.77)	1.25 (0.86-1.83)	1.25 (0.85-1.83)
High	-	1.93 (1.35-2.77)	1.94 (1.35-2.79)	2.08 (1.43-3.02)	2.01 (1.38-2.94)
City (relative to Bogotá)					
Medellín	-	-	0.88 (0.57-1.36)	0.90 (0.58-1.39)	0.83 (0.53-1.30)
Cali	-	-	1.22 (0.78-1.89)	1.12 (0.72-1.75)	1.11 (0.71-1.74)
Barranquilla	-	-	0.76 (0.48-1.19)	0.68 (0.43-1.07)	0.68 (0.43-1.09)
Bucaramanga	-	-	1.15 (0.70-1.91)	1.06 (0.63-1.77)	1.07 (0.64-1.80)
BMI (relative to normal)					
Overweight	-	-	-	1.07 (0.74-1.54)	1.09 (0.75-1.58)
Obesity	-	-	-	2.02 (1.33-3.06)	2.02 (1.33-3.07)
Diabetes	-	-	-	-	2.03 (1.26-3.26)

	SFA <7% of TCI				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	1.25 (0.73-2.14)	1.27 (0.74-2.19)	1.27 (0.74-2.2)	1.24 (0.71-2.19)	1.26 (0.71-2.22)
Age (per year)	1.01 (1.00-1.03)	1.02 (1.00-1.03)	1.02 (1.00-1.03)	1.01 (1.00-1.03)	1.02 (1.00-1.03)
SEL (relative to low)					
Medium	-	0.60 (0.33-1.10)	0.59 (0.32-1.10)	0.59 (0.32-1.10)	0.59 (0.32-1.11)
High	-	0.16 (0.06-0.42)	0.15 (0.06-0.41)	0.16 (0.06-0.41)	0.16 (0.06-0.42)
City (relative to Bogotá)					
Medellín	-	-	0.64 (0.27-1.52)	0.63 (0.25-1.55)	0.64 (0.26-1.58)
Cali	-	-	1.05 (0.48-2.29)	1.11 (0.51-2.45)	1.13 (0.51-2.49)
Barranquilla	-	-	1.19 (0.55-2.58)	1.24 (0.57-2.71)	1.22 (0.56-2.67)
Bucaramanga	-	-	1.32 (0.52-3.30)	1.25 (0.50-3.16)	1.22 (0.48-3.10)
BMI (relative to normal)					
Overweight	-	-	-	2.02 (1.03-3.94)	2.01 (1.03-3.91)
Obesity	-	-	-	0.89 (0.38-2.07)	0.91 (0.39-2.14)
Diabetes	-	-	-	-	0.55 (0.19-1.64)
	MUFA >=12% of TCI				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	0.64 (0.45-0.92)	0.63 (0.44-0.90)	0.62 (0.44-0.90)	0.61 (0.42-0.88)	0.60 (0.41-0.87)
Age (per year)	0.99 (0.98-1.00)	0.99 (0.98-1.00)	0.99 (0.98-1.00)	0.99 (0.98-1.00)	0.99 (0.98-1.00)
SEL (relative to low)					
Medium	-	1.35 (0.89-2.05)	1.35 (0.88-2.06)	1.31 (0.85-2.00)	1.30 (0.85-2.00)
High	-	2.34 (1.47-3.72)	2.46 (1.54-3.95)	2.38 (1.48-3.83)	2.32 (1.44-3.74)
City (relative to Bogotá)					
Medellín	-	-	0.67 (0.40-1.11)	0.68 (0.41-1.14)	0.66 (0.39-1.10)
Cali	-	-	0.71 (0.42-1.20)	0.71 (0.42-1.22)	0.71 (0.41-1.20)
Barranquilla	-	-	1.03 (0.59-1.82)	1.05 (0.59-1.86)	1.06 (0.60-1.88)
Bucaramanga	-	-	0.45 (0.25-0.81)	0.46 (0.26-0.83)	0.47 (0.26-0.84)
BMI (relative to normal)					
Overweight	-	-	-	0.84 (0.55-1.29)	0.86 (0.56-1.32)
Obesity	-	-	-	0.85 (0.52-1.40)	0.84 (0.51-1.38)
Diabetes	-	-	-	-	1.70 (0.91-3.19)
	Fiber >=14 g / 1000 Cal				
	Model 1	Model 2	Model 3	Model 4	Model 5
Male sex	0.61 (0.37-0.99)	0.61 (0.37-0.99)	0.62 (0.38-1.01)	0.58 (0.35-0.97)	0.58 (0.35-0.96)
Age (per year)	1.03 (1.02-1.05)	1.03 (1.02-1.05)	1.04 (1.02-1.05)	1.04 (1.02-1.05)	1.04 (1.02-1.05)
SEL (relative to low)					
Medium	-	1.04 (0.57-1.89)	0.94 (0.51-1.73)	0.91 (0.49-1.69)	0.91 (0.49-1.68)
High	-	1.52 (0.86-2.68)	1.53 (0.86-2.72)	1.47 (0.82-2.64)	1.46 (0.81-2.61)
City (relative to Bogotá)					
Medellín	-	-	0.21 (0.08-0.51)	0.21 (0.08-0.52)	0.21 (0.08-0.51)
Cali	-	-	0.7 (0.36-1.34)	0.72 (0.37-1.4)	0.71 (0.37-1.39)
Barranquilla	-	-	0.53 (0.26-1.07)	0.54 (0.27-1.11)	0.55 (0.27-1.11)
Bucaramanga	-	-	0.68 (0.31-1.5)	0.69 (0.31-1.53)	0.69 (0.31-1.53)
BMI (relative to normal)					
Overweight	-	-	-	1.09 (0.62-1.92)	1.09 (0.62-1.92)
Obesity	-	-	-	0.76 (0.39-1.49)	0.76 (0.38-1.48)
Diabetes	-	-	-	-	1.31 (0.67-2.56)

Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model 3 had all variables in model 2 plus BMI, model 4 had all variables in model 3 plus city, and model 5 had all variables in model 4 plus diabetes status. Data are OR (95%CI).TCI: Total caloric intake.

DISCUSSION

We performed a population-based study to describe diabetes prevalence and associated dietary nutrient ingestion patterns in five Colombian cities representing the main regions of the country. We found an overall prevalence of 10.1% based on random plasma glucose, self-reported diabetes or medication use. Diabetes was more common with older age, higher SEL, excess body weight, abdominal obesity, and among residents of Medellin. The association between diabetes prevalence and education was dependent on sex: A higher educational level was associated with a lower prevalence of diabetes among women and with a higher prevalence of diabetes among men. People with diabetes reported significantly less caloric intake than those without diabetes, a difference was also present for most macronutrients, but retained statistical significance after adjustment only in the case of dietary sodium. When compared with current guidelines, the proportion of individuals with diabetes not achieving dietary recommendations for SFA, MUFA, trans fats, fiber and sodium was remarkably high. We also found that the odds of achieving dietary recommendations were largely influenced by sex, age group, city of residence and, in the case of dietary protein, diabetes status.

The reported prevalence of diabetes in Colombia varies widely across studies and official documents, reflecting a lack of accurate population-level data, a problem common to many developing countries. The International Diabetes Federation Diabetes Atlas 2019 estimated an adjusted diabetes prevalence of 7.4% for the Colombian population (36), and the World Health Organization in its 2016 Diabetes Country Profiles reported a total prevalence of 8.0% (12). Meanwhile, the above-mentioned PURE study reported a prevalence of 11.1% for the population aged 35 to 70 from upper-middle income countries (13), much higher than the national survey done by Colombian government in 2007 (37), which found a 3.5% prevalence of self-reported diabetes in adults aged 18 to 69 (38). Results from regional studies are similarly heterogeneous. The CARMELA Study, a population-based study in large Latin American cities, found a diabetes prevalence of 8.1% in Bogotá in 2006 (39), similar to the 8.9% found in the Colombian Caribbean city of Cartagena in 2005 (40). A comparison of our findings with prior studies reveals that the diabetes epidemic seems to be progressing faster in smaller cities in Latin America. For example, diabetes prevalence in a 2006 study of adults in Bucaramanga was only 4%, while we found 7.4%

in the same city (41). We found a comparable diabetes prevalence for most of the cities except for Medellin, where we found a much larger figure. A population study undertaken in Medellin and its suburbs in 2008-2010 (42) found a prevalence of high plasma glucose (fasting plasma glucose >100 mg/dL or taking antidiabetic medication) of 19.8%, quite comparable to our 20.1% by random plasma glucose>200 mg/dL or diabetes self-report, despite the different definition. By comparison with results from both IDF and WHO estimates and from national studies, our results seem to confirm a sizable increase in the prevalence of diabetes in Colombian cities. Further studies are needed in order to identify potential genetic, demographic or cultural reasons for the high prevalence of hyperglycemia in this region of the country.

Worldwide, the prevalence and societal burden of diabetes have been increasing steadily in recent years. Diabetes has moved from being the tenth most relevant cause of disability-adjusted life years (DALYs) lost in 1990, to being the fourth in 2005, and the third in 2015 (43). The rapid expansion of the diabetes epidemic is being driven mostly by small prevalence increases in largely populated Asian countries (China and India) (44), but also by sustained prevalence increases in developed countries in Europe and North America. According to the IDF Diabetes Atlas 2019, diabetes prevalence among adults in the North America and Caribbean region was estimated at 13.3%, while in Europe it was 8.9% (36). The most recent estimate of the US Centers for Disease Control places diabetes prevalence in the USA at 13.0% (45). Thus, our estimations worryingly place the prevalence of diabetes among urban adults from Colombia at a level close to that of developed countries, and to that of Latin American countries traditionally leading diabetes prevalence statistics like Brazil (11.4%) and Mexico (15.1%) (36). Overall, our study led to an estimate of diabetes prevalence much more plausible and coherent with international projections than data from existing national health surveys.

The most important independent correlate of diabetes in our study was increasing age, as has been described for most populations worldwide (43). Our study found an estimated prevalence of diabetes among older adults remarkably close to that encountered in recent surveys from the SABE study (17.5% in SABE Bogotá, executed in 2012 (20); 18.5% in SABE Colombia, executed in 2015 (19) and 20.6% in COPEN, executed in 2018). Thus, recent data support the idea of an accelerated increase in the prevalence of diabetes among older adults in Colombia. For the most

part, the relationship between socioeconomic status and diabetes is consistent in high-income countries: a lower position increases risk (46-49). Meanwhile, the magnitude and direction of this association in middle- and low-income countries is conflicting across studies, perhaps due to imperfect data, to the use of different proxies for SEL, or to the rapid development of demographic and nutritional transitions that affect them in ways different from what takes place in the developed world (50-52). In Colombia, the higher prevalence of *diagnosed* diabetes with higher SEL may be explained at least partially by increased access to medical care and diabetes screening with higher income (53).

Prior studies had found an interaction between sex and educational level, so that more educated women had a lower prevalence of diabetes. A large multi-national study reported increasing odds of diabetes as education increased among men from middle-income countries. For women, the association was flat or slightly negative (54). Other studies of the associations between socioeconomic variables and diabetes have also found a different pattern according to sex (55,56). Studies from Mexico (57) Argentina (58) and Brazil (59) have also documented higher rates of obesity and diabetes among more educated males and less educated females. Many factors could explain these results, but one that may apply to our context is a larger degree of body dissatisfaction among women, that increases with higher education. A study in Bogotá showed that women with higher education were more likely to identify thinner body silhouettes as their preferred ones (60). Our results complement a body of evidence suggesting that education of women may be a tool in the fight against the diabetes epidemic in developing countries.

We were surprised to find a lower self-reported weight-adjusted intake of calories and all macronutrients among persons with diabetes. An optimistic interpretation of this finding would be that it shows good adherence to dietary recommendations. However, such interpretation should be made with caution, as it is known that people with diabetes and obesity frequently underreport their caloric intake (61).

The fact that the lower mean intake of all nutrients but sodium in people with diabetes lost significance after multivariate adjustment, suggests that major sociodemographic factors (older age) and a higher BMI are the main factors explaining a lower reported dietary intake in persons

with diabetes. In any event, these differences did not result in increased odds of achieving dietary recommended intakes of key nutrients, as only reaching the %TCI from protein was independently associated with diabetes status.

Despite reporting quantitatively less intake of most nutrients, the relative proportion of macronutrients from each source in participants with diabetes was remarkably similar to that of people without diabetes. This finding also applied to fat subtypes: SFA, MUFA and PUFA represented a comparable share of TCI regardless of diabetes status. This points out that individuals with diabetes (many of whom know already know about of their diabetes status), are not modifying their diets enough to intentionally increase the percent of Calories from MUFA, as well as reducing their intake of SFA and TFA. A survey of patients with type 2 diabetes from general practices in the Netherlands found a 15% mean TCI from SFA at the moment of diagnosis, which had descended to 11.9% by four years after diagnosis (62). This is still far from the recommendation of <7% TCI from SFA. Thus, excessive consumption of SFA by people with diabetes seems to be a ubiquitous problem.

The intake of dietary fiber was equally concerning, in this case because of too little consumption, a problem that was more evident in participants who were younger, male, or lived in Medellin. A meta-analysis of randomized controlled trials concluded that diets with foods rich in fiber up to 42.5 g/day reduced glycated hemoglobin by a mean 0.55% and fasting plasma glucose by 9.9 mg/dL in persons with diabetes (63). Hence, a low consumption of dietary fiber constitutes a lost opportunity for improving the health of persons with diabetes. Dietary TFA are a powerful cardiovascular risk factor, even at intakes as low as 2% of TCI. For this reason, their intake is restricted by most dietary guidelines to less than 1g/day, with special emphasis on populations at high baseline risk for cardiovascular disease, like people with diabetes or older people (64). We found that only one in every five individuals with diabetes was achieving this goal, and the odds of achieving it were significantly lower with younger age or higher SEL, probably in relation with a higher consumption of processed, industrialized foods (64). TFA intake is an independent predictor of total and cardiovascular mortality (65), so extreme efforts should be put in place in order to limit their consumption both in the general population and among persons with diabetes.

Our results bring out many areas of potential intervention for nutritional prevention, which are particularly relevant in our context. Nutritional education of people with diabetes in developing countries is an urgent measure with large potential benefits and minimal risks.

Limitations of our study include the entirely urban sample, given the recent increase in obesity in rural areas in the continent (66) and Colombia (67). It is important, however, that the proportion of total population living in urban centers is in Colombia is 77.1% (68), a result of accelerated urbanization induced by years of internal conflict that has impacted the epidemiologic profile of the country (14). Another relevant limitation was the unavailability of oral glucose tolerance test (OGTT) data, so our ascertainment of diabetes status relied on random plasma glucose measurement and diabetes self-report, which may lead to underestimation of the true disease prevalence. OGTT is the most sensitive test for diabetes diagnosis but performing it would have imposed great complexities on the logistics of the study. We acknowledge that the prevalences we report, high as they seem, are most likely an underestimation. Concerning the instrument to measure dietary intake, FFQs have the advantage of inquiring about usual (rather than recent) intake, to be more comprehensive than 24-hour dietary recalls, and not as susceptible to modification by recent diet as food diaries. They do have the limitations of tending to overestimate total Caloric intake, and of having to be adjusted for different populations. However, the problems inherent to recall bias exist for all dietary assessment tools, except for food diaries, which are seldom used in epidemiology. FFQs have been shown to successfully assess average dietary intake up to 4 years prior to their application (69). Finally, our study did not collect detailed information on lifestyle variables like smoking or physical activity, which may explain or correlate with the described dietary intakes.

In summary, our results confirm a continued progression of the diabetes epidemic in Colombia, a middle-income country, and its relationship with demographic and socioeconomic factors. We also found remarkably low rates of achievement of key nutritional goals among individuals with diabetes, and identified factors associated with their achievement. Further research focused in rural areas is needed in order to build a complete the picture of evolution of the diabetes epidemic in the developing world.

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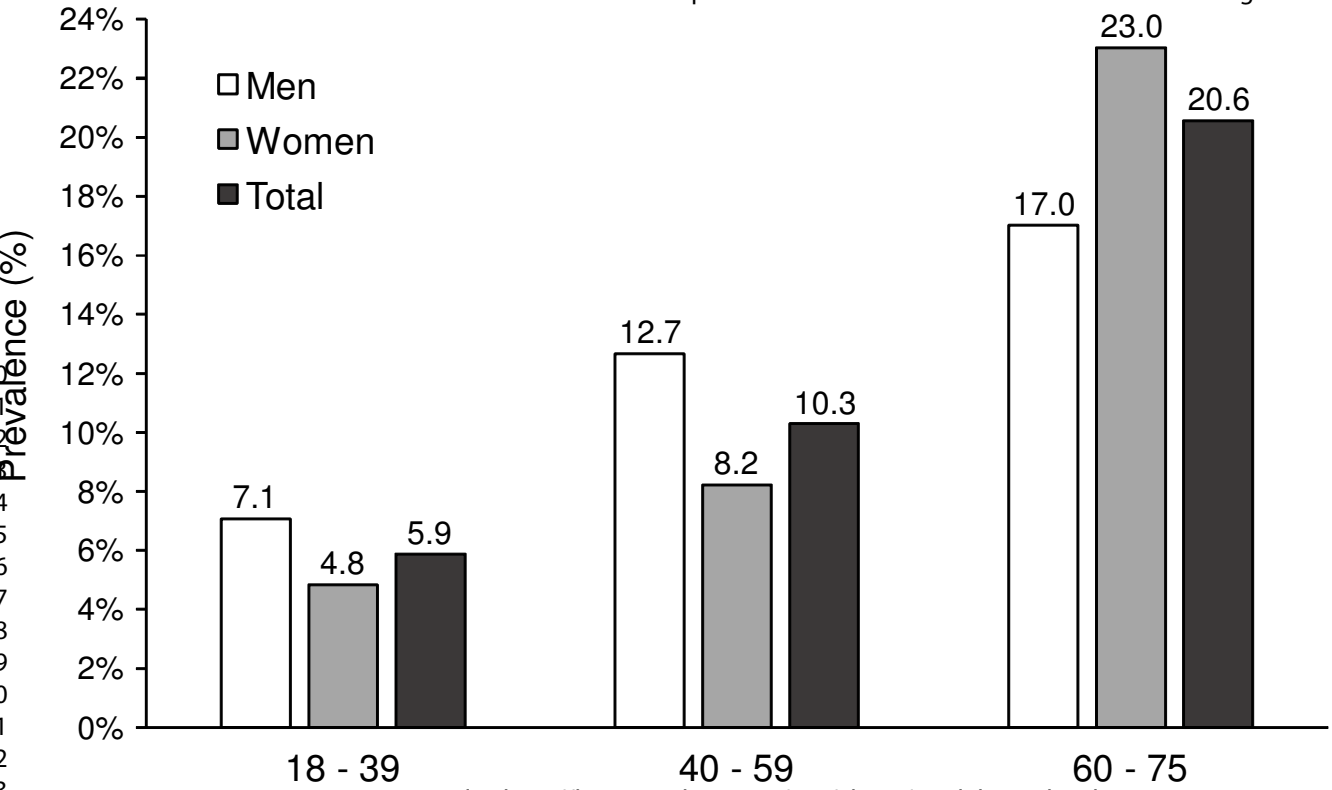
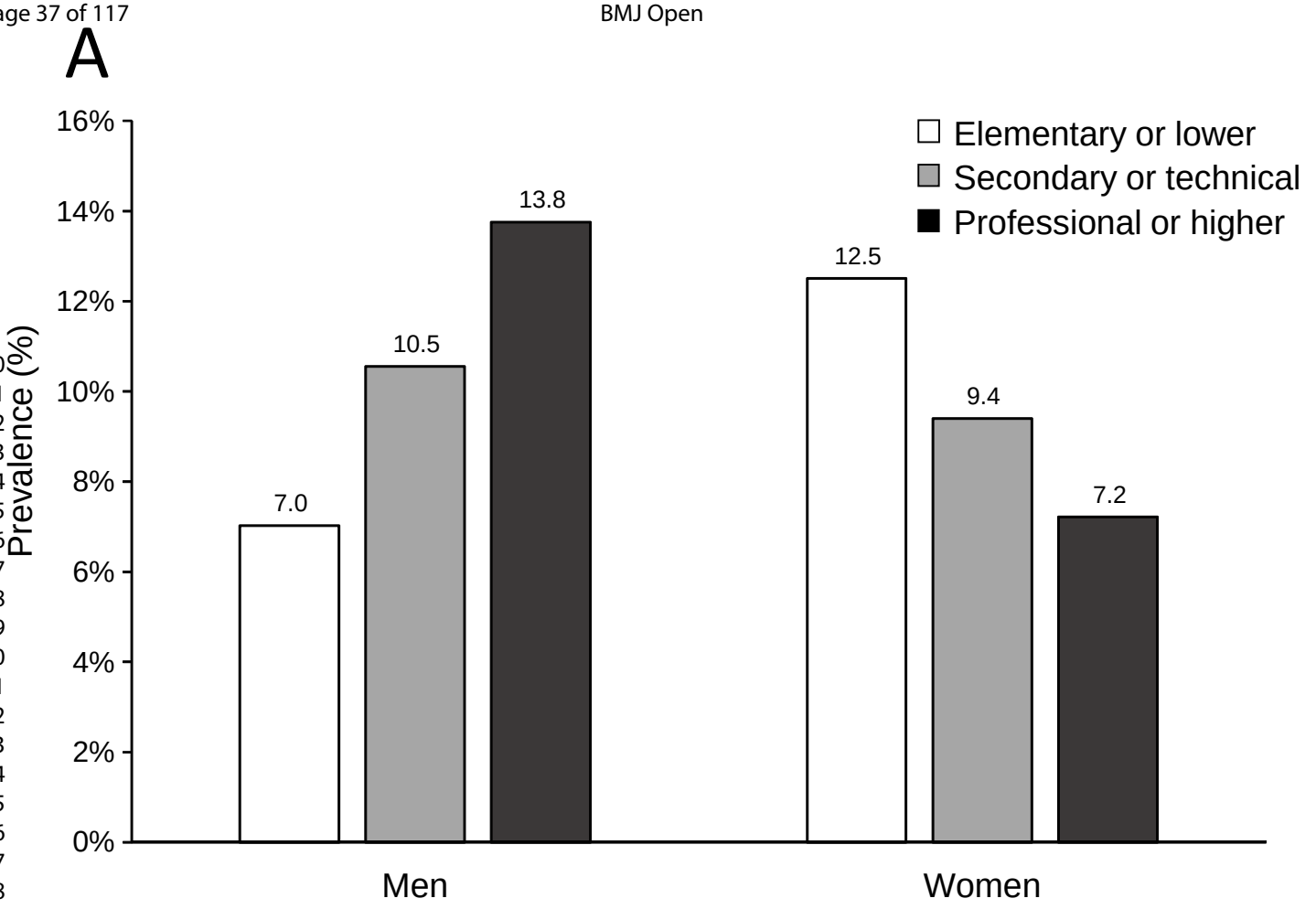
Figure legends

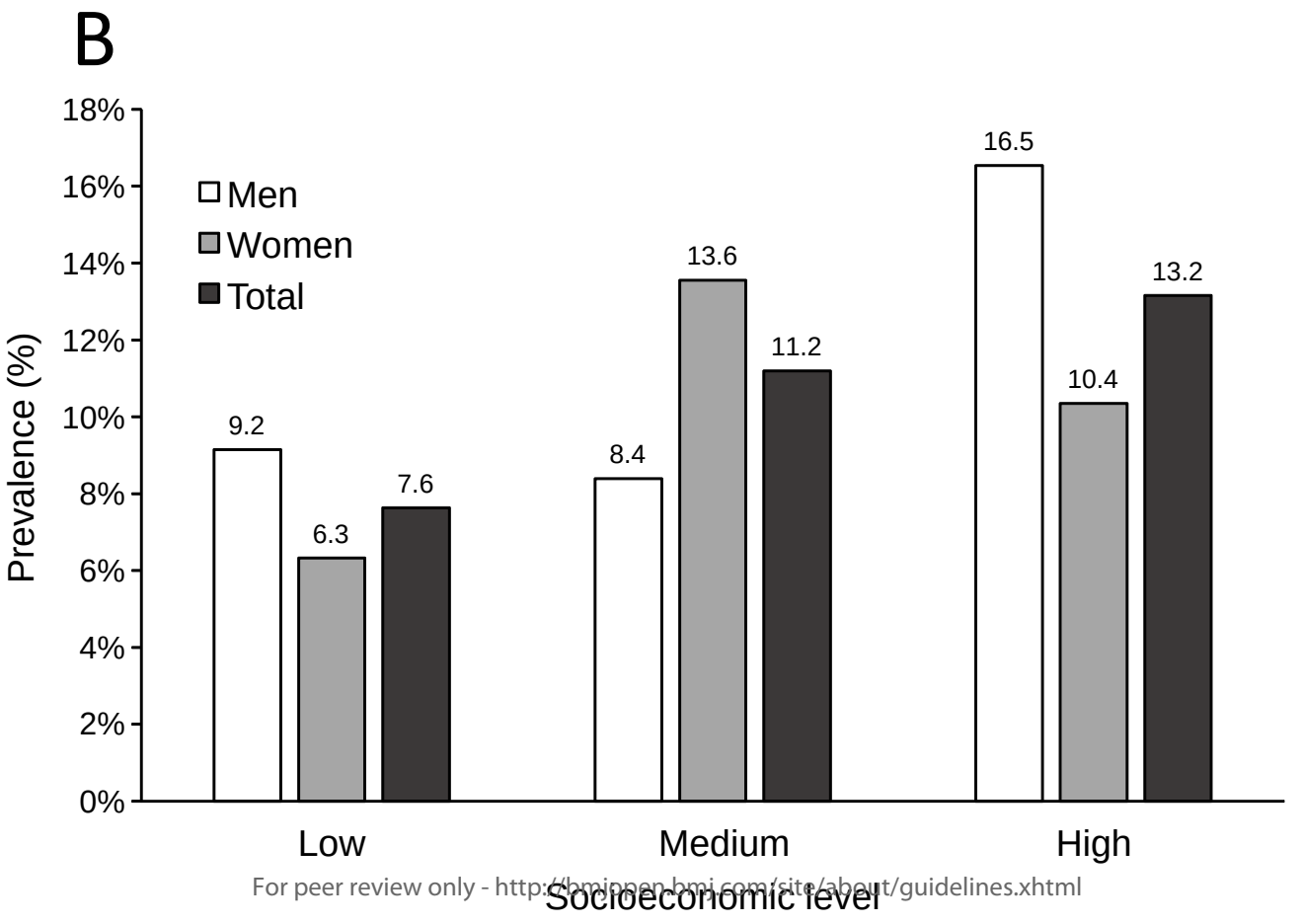
Figure 1. Prevalence of diabetes, by age and sex. Data are prevalences using sampling weights. P-value for the overall difference in prevalence among age groups <0.001. P-value for the trend in diabetes prevalence with increasing age group <0.001.

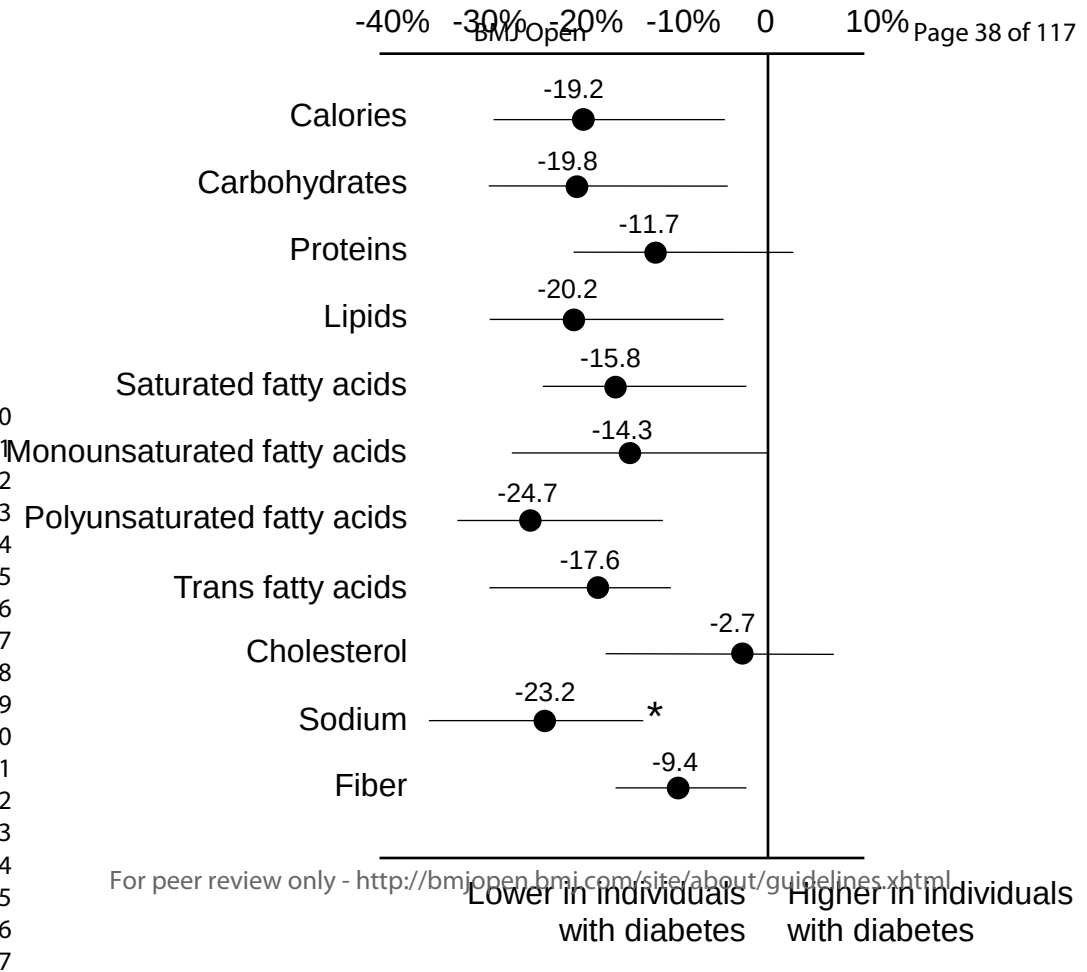
Figure 2. Prevalence of diabetes, by educational level (Panel A) and socioeconomic level (Panel B), and sex. Educational level refers to the highest level completed. Socioeconomic level (SEL) was classified according to Colombia´s official Statistics Department-DANE stratification scheme. Low SEL includes strata 1 and 2, medium SEL includes only stratum 3, and high SEL includes strata 4, 5 and 6. Data are prevalences using sampling weights. P-value for the overall difference in diabetes prevalence among socioeconomic levels=0.11. P-value for the trend in diabetes prevalence with increasing socioeconomic level=0.04.

Figure 3. Difference in adjusted nutrient intake (in g/d), between individuals with diabetes and individuals without diabetes. Dots represent medians and lines represent Q1-Q4. Differences were estimated using linear regressions including diabetes status, age, sex, BMI and SEL as predictors. *p=0.013 for the adjusted comparison of individuals with versus without diabetes.





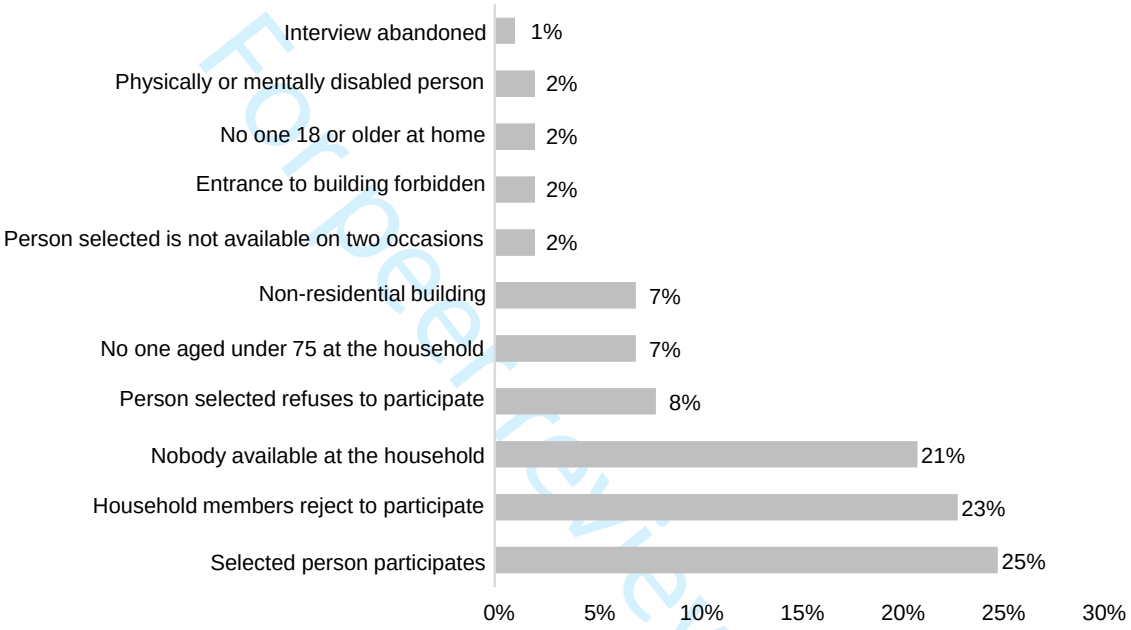




Dietary intake among urban adults with diabetes: COPEN (Colombian Nutritional Profiles), a cross-sectional study

Supplementary Material

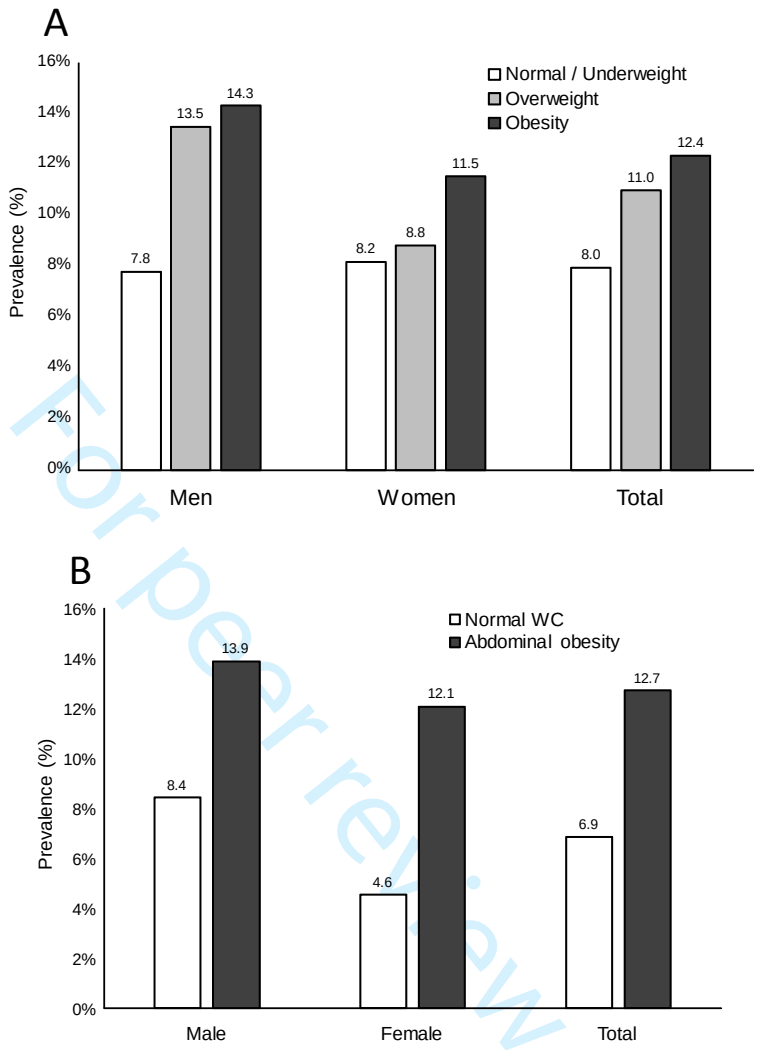
Supplemental Figure 1. Results of 7640 contacts for recruitment of study participants.



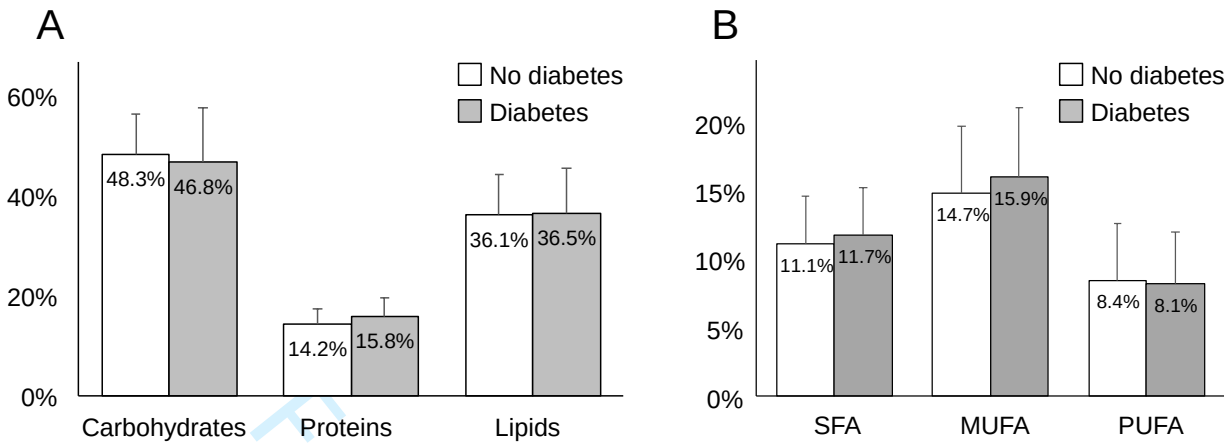
Supplemental table 1. Proportion of individuals achieving different dietary recommendations, according to sex, age group, city, SEL and educational level.

		Trans fat <1g/day	Sodium <2300 mg/day	Protein >=15% of TCI	SFA <7% of TCI	MUFA >=12% of TCI	Fiber >=14 g / 1,000 Cal
Sex	Male n=331	66 (19.9%)	18 (5.4%)	129 (39%)	29 (8.8%)	246 (74.3%)	28 (8.5%)
	Female n=405	76 (18.8%)	46 (11.4%)	155 (38.3%)	29 (7.2%)	331 (81.7%)	53 (13.1%)
Age group	18 to 39 n=288	42 (14.6%)	14 (4.9%)	103 (35.8%)	20 (6.9%)	234 (81.3%)	14 (4.9%)
	40 to 59 n=235	52 (22.1%)	30 (12.8%)	101 (43%)	14 (6%)	179 (76.2%)	33 (14%)
	60 to 75 n=213	48 (22.5%)	20 (9.4%)	80 (37.6%)	24 (11.3%)	164 (77%)	34 (16%)
City	Bogotá n=250	37 (14.8%)	23 (9.2%)	97 (38.8%)	20 (8%)	205 (82%)	39 (15.6%)
	Medellin n=142	22 (15.5%)	12 (8.5%)	51 (35.9%)	8 (5.6%)	106 (74.6%)	6 (4.2%)
	Cali n=126	35 (27.8%)	13 (10.3%)	54 (42.9%)	11 (8.7%)	96 (76.2%)	15 (11.9%)
	Barranquilla n=132	24 (18.2%)	5 (3.8%)	44 (33.3%)	12 (9.1%)	109 (82.6%)	12 (9.1%)
	Bucaramanga n=86	24 (27.9%)	11 (12.8%)	38 (44.2%)	7 (8.1%)	61 (70.9%)	9 (10.5%)
SEL	Low n=297	67 (22.6%)	22 (7.4%)	96 (32.3%)	35 (11.8%)	218 (73.4%)	26 (8.8%)
	Medium n=219	37 (16.9%)	15 (6.8%)	82 (37.4%)	18 (8.2%)	170 (77.6%)	24 (11%)
	High n=220	38 (17.3%)	27 (12.3%)	106 (48.2%)	5 (2.3%)	189 (85.9%)	31 (14.1%)
Educational level	Elementary or lower n=156	45 (28.8%)	16 (10.3%)	53 (34%)	20 (12.8%)	104 (66.7%)	16 (10.3%)
	Secondary or technical n=427	73 (17.1%)	28 (6.6%)	158 (37%)	28 (6.6%)	339 (79.4%)	47 (11%)
	Professional or higher n=153	24 (15.7%)	20 (13.1%)	73 (47.7%)	10 (6.5%)	134 (87.6%)	18 (11.8%)
Diabetes	Yes n=90	18 (20%)	12 (13.3%)	49 (54.4%)	5 (5.6%)	75 (83.3%)	14 (15.6%)
	No n=646	124 (19.2%)	52 (8%)	235 (36.4%)	53 (8.2%)	502 (77.7%)	67 (10.4%)

Data are n (%).



Supplemental Figure 2. Prevalence of diabetes, by body-mass index (Panel A) and waist circumference (Panel B) status. Underweight was defined as a body mass index (BMI) of less than 18.5 Kg/m^2, normal weight as a BMI between 18.5 and less than 25 Kg/m^2, overweight as a BMI between 25 and less than 30 Kg/m^2, and obesity as a BMI of 30 or higher. Abdominal obesity was defined as a waist circumference of 90 cm or higher in women, and 94 cm or higher in men. Data are prevalences using sampling weights.



Supplemental Figure 3. Distribution of total caloric intake (TCI) from each macronutrient (Panel A) and percent TCI from each fat type (Panel B) according to diabetes status. SFA: Saturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA: Polyunsaturated fatty acids. $p<0.001$ for the difference in percent TCI from protein, and $p=0.031$ for the difference in percent TCI from MUFA.

1. DATOS GENERALES DEL PROYECTO:

Versión del Proyecto	4.0
Fecha de la Versión	02 de septiembre de 2018
Título del Proyecto	Estudio Colombiano de Perfiles Nutricionales – COPEN - 2018
Investigadores	*Carlos O Mendivil, MD, PhD* Profesor Asociado, Facultad de Medicina, Universidad de los Andes *Eddy Carolina Betancourt, MSc* Nutrition and Health Manager, Team Foods Colombia. *Angélica Montaño Rodríguez, RD, Esp* Nutricionista, Especialista en Epidemiología. *María Carolina Chacón Vargas* Directora de Estudios, Centro Nacional de Consultoría *Alejandra Campuzano Acero* Directora de Estudios, Centro Nacional de Consultoría
Duración del proyecto (Meses)	5
Palabras Clave	Alimentación, nutrición, ingesta, patrones, diabetes, obesidad, malnutrición, Colombia

2. Resumen Ejecutivo

2.1 Introducción:

Los hábitos y patrones alimentarios constituyen una de las piedras angulares del cuidado de la salud en las poblaciones, pues se asocian con la protección o el riesgo de desarrollar múltiples enfermedades, especialmente las de carácter crónico y no transmisible. Para todas las naciones el conocimiento de los hábitos alimentarios de su población es un insumo indispensable en la formulación de políticas públicas. Para la industria de alimentos, dicho conocimiento permite analizar todos los segmentos en los que puede contribuir al mejoramiento de la calidad de la dieta desde el desarrollo de nuevos productos. En Colombia, la información sobre hábitos alimentarios incluyendo ingesta de alimentos, macronutrientes, distribución de los mismos en tiempos de comida y diferenciación por regiones es muy limitada.

2.2 Objetivos:

Evaluar el nivel de consumo habitual de múltiples alimentos y bebidas, así como de los macro y micronutrientes aportados por ellos, en las principales ciudades de Colombia. El estudio busca también establecer asociaciones entre ingesta de alimentos o grupos de alimentos y variables como tiempos de comida, lugar de consumo, región del país, sexo y grupo etario, para así aproximarse a los patrones alimentarios prevalentes en el país. Mediante análisis multivariado de factores, se analizará de manera exploratoria que alimentos o grupos de alimentos tienden a consumirse en el mismo espacio o tiempo. Por último, la realización de medidas antropométricas y de una glucometría al azar y hemoglobina glucosilada en los participantes permitirá buscar asociaciones entre la ingesta de alimentos y macronutrientes y con la presencia de sobrepeso, obesidad y diabetes mellitus.

2.3 Metodología:

Se estudiarán 1,910 personas entre 2 y 75 años de edad, buscando una muestra representativa del universo de personas en ese grupo etario que forman parte de los hogares en Bogotá, Cali, Medellín, Barranquilla y Bucaramanga. Los participantes se seleccionarán a partir de un marco muestral constituido por el último censo de población disponible y el marco geoestadístico nacional elaborado por el DANE; para la clasificación socioeconómica se usará la información de la Superintendencia de Servicios Públicos. El diseño muestral será multietápico en donde en cada etapa se seleccionarán respectivamente sectores cartográficos, manzanas, hogares y personas. La información colectada en cada participante incluirá datos sociodemográficos básicos, un cuestionario de frecuencia de consumo de 150 ítems validado en población colombiana adaptado a este estudio, medidas antropométricas básicas y una muestra de sangre capilar para determinación de glucometría al azar y hemoglobina glucosilada A1c. Empleando ponderaciones por día de acuerdo a la frecuencia de consumo y las tablas de alimentos colombianos del ICBF suplementadas con otras

fuentes, se estimará la ingesta de macronutrientes (carbohidratos, proteínas, grasas totales y por subtipo) y micronutrientes en la muestra de estudio. Mediante técnicas de análisis factorial se analizará de manera exploratoria que alimentos, grupos de alimentos y/o nutrientes tienden a agruparse en el mismo espacio, tiempo o personas. Se determinará la prevalencia de alteraciones nutricionales por defecto y por exceso (desnutrición, sobrepeso y obesidad), estados prediabéticos y diabetes mellitus de acuerdo a los criterios vigentes.

2.4 Resultados esperados:

Este estudio constituirá una primera aproximación a los patrones de ingesta alimentaria y su asociación con el estado nutricional y las alteraciones del metabolismo de carbohidratos en población urbana en Colombia. Sus resultados servirán como un valioso insumo para la toma de decisiones por parte de la sociedad civil, las autoridades y la industria.

3. Planteamiento del problema y justificación

3.1 Antecedentes

Contribuir al mejoramiento de la situación alimentaria y nutricional de la población, ha sido uno de los compromisos que Colombia ha ratificado ante el mundo. Colombia se comprometió en la Cumbre Mundial de Alimentación (1996) con el diseño e implementación de un sistema de evaluación y seguimiento en aspectos nutricionales y alimentarios, que permita formular y orientar las políticas de promoción de la salud, alimentación y estilos de vida saludables (ICBF, 2008). No obstante, es sólo hasta el 2005 cuando el Instituto Colombiano de Bienestar Familiar (ICBF) en coordinación con entidades asesoras de orden nacional e internacional, realiza por primera vez la Encuesta de Situación Nutricional (ENSIN) de manera conjunta con la Encuesta Nacional de Demografía y Salud (ENDS) (ICBF, 2008).

Los resultados de la ENSIN 2005 permitieron contar con información sobre la condición de salud y el estado nutricional de la población colombiana medido por indicadores antropométricos y bioquímicos, lactancia materna y alimentación complementaria, evaluación cualitativa de la seguridad alimentaria en el hogar, actividad física, tiempo dedicado a ver televisión, auto-percepción del peso corporal y conductas asociadas (ICBF, 2008). En esta edición de la ENSIN, la ingesta alimentaria se evaluó en 39,413 hombres y mujeres entre 2 y 64 años de edad mediante ingesta dietética por recordatorio único de 24 horas. Para aproximarse al tamaño de cada porción de alimento se emplearon modelos de alimentos y figuras geométricas que reproducían diferentes porciones y tamaños. El foco estuvo en tratar de determinar la proporción de individuos que se encontraban por debajo del requerimiento promedio estimado (Estimated Average Requirement – EAR) de energía, proteínas, carbohidratos, fibra dietaria, grasa, vitaminas A y C, hierro, calcio y zinc. Entre los hallazgos centrales de ENSIN 2008 se encontró una ingesta calórica promedio de 1,758 Calorías (IC 95%: 1,750-1,766), siendo mayor en hombres que en mujeres (2,019 vs 1,511 Cal) y siendo menor que el promedio en hogares del SISBEN 1 y 2, y en zonas rurales respecto a las urbanas. En cuanto a ingesta de proteínas, se reportó la prevalencia de *déficit de proteína dietaria* total, por regiones y por niveles del SISBEN, pero no el dato de ingesta proteica total o por subgrupos. Algo similar sucedió con los reportes sobre lípidos, carbohidratos y micronutrientes, se reportó la prevalencia de déficit pero no los valores de ingesta diaria (ICBF, 2008).

Si bien el recordatorio único de 24 horas es un método bastante flexible, sólo refleja ingesta del día inmediatamente anterior y por tanto está sujeto a un fuerte sesgo de ingesta reciente. Su utilidad radica en la estimación de medias poblacionales de ingesta sólo si se cuenta con tamaños muestrales muy grandes. Por esa razón, estudios poblacionales recientes recomiendan tomar el promedio de cuatro e incluso hasta ocho recordatorios de 24 horas, persiguiendo estimar adecuadamente la ingesta *habitual* de los individuos (Holmes, 2008; Jackson, 2008).

En la segunda versión de la ENSIN 2010 se valoró la ingesta dietaria únicamente mediante un formulario cualitativo, que evaluaba la prevalencia de "Prácticas de alimentación de interés en nutrición y salud pública" (ICBF, 2011), pero no la ingesta total de alimentos o nutrientes. En la ENSIN 2015, se abordó la situación alimentaria y nutricional desde el enfoque de determinantes sociales. Se espera aún la publicación de los diferentes capítulos de resultados, pero se ha anunciado que incluirán antropometría y autopercepción de imagen, déficit de vitaminas y minerales de interés en salud pública, seguridad alimentaria, hábitos alimentarios y prácticas alimentarias aplicando metodologías cualitativas, actividad física, comportamientos sedentarios y fuerza prensil (ICBF, 2018). En cuanto a ingesta dietaria, se valoró ingesta dietética por frecuencia de consumo y recordatorio de 24 horas. Sin embargo el objetivo no fue estimar ingesta de nutrientes sino determinar los alimentos de mayor consumo, la cantidad promedio consumida por alimento, la proporción de individuos a riesgo por deficiencia de energía y nutrientes y la calidad de la alimentación complementaria.

Para el propósito de capturar la ingesta *habitual y regular* de múltiples alimentos individuales, la metodología de mejor desempeño y que logísticamente se presta a un estudio poblacional de un solo contacto, es el cuestionario de frecuencia de consumo semicuantitativo. Una de las limitantes que se señala con esta metodología es la imposibilidad de especificar el tamaño exacto de la porción consumida, ya que cada ítem viene pre-especificado en una porción usual. En el caso de los alimentos que vienen en porciones "naturales" (por ejemplo un huevo, una rebanada de pan), esto no constituye un gran problema; pero en el caso de alimentos con gran variación en su tamaño de porción y grado de cocción (por ejemplo, la carne), podría llegar a representarlo. Sin embargo, estudios en los que se ha calculado en los mismos sujetos la ingesta de macro y micro nutrientes con cuestionarios que pre-especifican el tamaño de porción, o que utilizan modelos realistas de alimentos para que el participante seleccione el que mejor se aproxima a su porción habitual, han encontrado coeficientes de correlación de Spearman entre las dos estimaciones que oscilan entre 0.93 y 0.99 (Hernández-Avila, 1988). Más aún, estudios de comparación directa han hallado que la mayor proporción variabilidad inter-individual en el consumo de nutrientes se debe a la frecuencia de consumo, estando en segundo lugar el tamaño de la porción (que se puede pre-especificar) y en último la ingesta anterior (Samet, 1984). Ello indica que la información adicional provista por la utilización de fotos o modelos es limitada, mientras que el grado de complejidad logística y costos que adiciona puede llegar a ser importante.

Existe el antecedente en Colombia de un estudio realizado para evaluar frecuencia de consumo de alimentos asociados con cáncer, adelantado por la Universidad Industrial de Santander y el Instituto Nacional de Cancerología en 2010 (Herrán 2010). Se propusieron formularios para evaluar la frecuencia de consumo de alimentos relacionados con riesgo de cáncer en cinco ciudades del país: Bogotá, Santa Marta, Cartagena, Barranquilla, Bucaramanga y su área metropolitana. Los formularios incluyeron entre 22 y 32 alimentos, dependiendo de ajustes para cada región. Se

encontraron coeficientes de maximización de varianza muy altos (en general mayores al 90%) para los principales nutrientes, indicando que la mayor parte de la variabilidad en el consumo de dichos nutrientes se puede explicar con los alimentos seleccionados en la lista. Este estudio permitió proponer cuestionarios regionalizados para valorar la ingesta de alimentos o nutrientes potencialmente carcinógenos, pero no permitió aproximarse a la ingesta global de alimentos o nutrientes, ni correlacionarlos con variables demográficas o clínicas de los participantes (Herrán 2010).

Con este contexto general, y dado el notorio vacío de conocimiento que existe en Colombia en cuanto a estimaciones de la ingesta poblacional de macro y micronutrientes, su asociación con factores sociodemográficos, con el estado nutricional y con la presencia de alteraciones del metabolismo de carbohidratos, se adelantará el estudio COPEN. En este estudio se busca realizar una estimación (aproximada pero realista y actualizada), de la ingesta de los principales macro y micronutrientes en la población de las 5 ciudades más pobladas de Colombia. Esto permitirá además de explorar los hábitos y patrones alimentarios más prevalentes, analizar la asociación que puede existir entre ingesta de cada macronutriente y características demográficas, socioeconómicas, el estado nutricional, y el nivel de actividad física de la población de los principales centros urbanos del país.

4. Objetivos

4.1 Objetivo general

Estimar la ingesta diaria promedio de los principales alimentos y bebidas, macronutrientes y micronutrientes en una muestra representativa de las cinco mayores ciudades capitales de Colombia, y su asociación con múltiples factores de interés.

4.2 Objetivos específicos

1- Estimar en la población de estudio la ingesta diaria promedio de alimentos y bebidas, dentro de los siguientes grupos: 1. Lácteos, 2. Huevos, carnes y pescados, 3. Leguminosas y harinas, 4. Frutas, 5. Verduras y hortalizas, 6. Aceites y grasas, 7. Dulces y postres, 8. Bebidas, 9. Suplementos y 10. Misceláneos.

2- Estimar la ingesta diaria promedio de energía (Calorías) y de varios macro y micronutrientes en la población de estudio: Carbohidratos, lípidos, proteína, fibra dietaria, ácidos grasos saturados, ácidos grasos monoinsaturados, ácidos grasos poliinsaturados, ácidos grasos trans, colesterol, ácido láurico, ácido miristico, ácido palmítico, ácido esteárico, ácido oleico, ácido linoleico, ácido gamma-linolénico, ácido miristoléico, ácido alfa-linolenico, ácido vaccénico, ácido eicosapentaenoico, ácido docosahexaenoico, vitamina A, vitamina E, vitamina K, vitamina D, tiamina, riboflavina, niacina, vitamina_c, folato, zinc, hierro, fósforo, calcio, sodio y potasio.

3- Explorar la existencia de asociaciones entre la ingesta de alimentos o nutrientes y variables asociadas a patrones alimentarios como región del país, tiempos de comida y lugar de consumo.

4- Explorar la existencia de asociaciones entre la ingesta de alimentos o nutrientes y variables sociodemográficas: Sexo, estrato socioeconómico y grupo etario.

5- Explorar la existencia de asociaciones entre la ingesta de alimentos o nutrientes y el estado nutricional según índice de masa corporal en adultos, o mediante los percentiles relevantes en participantes menores de 18 años.

6- Explorar la existencia de asociaciones entre la ingesta de alimentos o nutrientes y la presencia de alteraciones del metabolismo de carbohidratos: prediabetes o diabetes.

5. Métodos

5.1 Diseño del estudio:

Marco de Muestreo

El marco de muestreo será la información del último censo de población disponible. La fuente de la cartografía es el marco geoestadístico nacional elaborado por- el DANE y para la clasificación socioeconómica se usará la información de la Superintendencia de Servicios Públicos.

Tamaño de la Muestra:

Con una muestra de 1,910 participantes seleccionados mediante el diseño explicado a continuación, el error de muestreo que tendrán los indicadores de resultados es de 2.2% (para los indicadores del total de 5 ciudades). El número de personas seleccionadas en la muestra será: 610 en Bogotá con un error de 4,0%, 390 en Medellín con un error de 5,0%, 390 en Cali con un error de 5,0%, 310 en Barranquilla con un error de 5,6% y 210 en Bucaramanga con un error de 6,8%.

Diseño de la Muestra

La selección de la muestra se hará en forma multietápica. Primero se seleccionarán sectores cartográficos, en los sectores seleccionados en la etapa anterior se seleccionarán manzanas, dentro de estas, hogares y finalmente las personas a entrevistar dentro del hogar. Las etapas de selección se describen a continuación.

Selección de sectores:

El departamento de Estadística del Centro Nacional de Consultoría (CNC) seleccionará una muestra aleatoria de sectores cartográficos.

Selección de secciones:

Cada una de las secciones en que se divide un sector seleccionado estará habilitada para realizar las encuestas correspondientes a una manzana. El número máximo de encuestas correspondientes a una manzana tendrá diferencias de acuerdo al estrato que represente, de la siguiente manera: en los estratos altos, generalmente las manzanas o bloques cartográficos corresponden a torres de apartamentos de conjuntos residenciales en cuyo caso se podrán hacer más encuestas. En cambio, en manzanas de barrios tradicionales comúnmente asociados a estratos 2 y 3 la cantidad de hogares es menor y por lo tanto el número de encuestas será menor. En promedio se realizarán ocho encuestas por sección cartográfica.

Selección de manzanas:

Se asignarán dos "Manzanas Eje" en cada sección. Las manzanas restantes de la sección servirán como "manzanas de reemplazo" en caso de que no se logre la muestra prevista en las manzanas Eje solo si tienen el mismo estrato moda de las manzanas seleccionadas. De esta forma el perímetro de cada grupo de manzanas será demarcado por los límites de la sección.

Selección de viviendas:

En cada costado de manzana se seleccionará la primera vivienda. En caso de que esté vacía, o de que se presente cualquier tipo de rechazo del hogar o del individuo seleccionado se reemplazará por otra vivienda dejando una de por medio. En esta etapa se utilizará un mecanismo para balancear la muestra por sexo: En la numeración par de cada calle o carrera se sortearán hombres en los hogares y en la numeración impar se sortearán mujeres.

Selección de hogares:

En caso de que en la vivienda seleccionada exista más de un hogar se seleccionará el hogar de la persona que abrió la puerta.

Selección de personas:

Se seleccionarán de manera aleatoria con la ayuda de la tabla de Kish, listando en cada hogar hombres o mujeres según sea el caso. Se listarán las personas mayores de 2 años y se seleccionará una persona aleatoriamente, si la persona seleccionada es de 13 años o menos responderá el adulto responsable por ella.

Control de Calidad en el muestreo

<u>Selección de sectores y manzanas:</u>

Controles en oficina:

La selección se efectúa partiendo de la combinación de las bases estratificadas de los municipios y las bases digitales de la cartografía DANE, es de anotar que las dos bases están al nivel de sector sección y manzana. Estas bases se unen en el paquete de georreferenciación ArcView lo cual asegura su correcta combinación. La base resultante de la combinación es la fuente para seleccionar la muestra independientemente para cada ciudad y estrato en forma completamente aleatoria.

- El departamento de estadística del Centro Nacional de Consultoría verifica que los sectores y manzanas seleccionadas en la muestra correspondan al estrato.
- El departamento de estadística genera un listado con las combinaciones de Sector, Sección y Manzana (relacionado al estrato) que se constituye en la muestra seleccionada.
- La base de datos con la muestra de manzanas seleccionadas es relacionada con la población proyectada al año correspondiente de las mismas, previendo el proceso de restitución de la población.

Controles en campo:

Los supervisores del Centro Nacional de Consultoría tienen experiencia en el manejo de cartografía lo cual asegura que las manzanas seleccionadas sobre la cartografía serán los puntos de inicio del trabajo de recolección.

Selección de viviendas y hogares:

Controles en oficina:

La existencia de una hoja de recorrido para cada formulario en la que se registra cada contacto realizado con dirección y su resultado, permite reconstruir sobre la cartografía el recorrido realizado y si se requiere se puede hacer una supervisión pormenorizada en campo del recorrido desde la coordinación de campo de cada ciudad.

Controles en campo:

Para la selección de hogares, que se realiza en campo, el supervisor de cada grupo de encuestadores contará con un manual que describe el procedimiento que debe seguir en la manzana para realizar la selección. Este manual explica el procedimiento paso a paso de tal forma que no quede en ningún momento al libre albedrío del grupo de trabajo.

Selección de Personas:

Controles en oficina:

El supervisor de campo verifica que el encuestador haya usado correctamente la tabla de Kish. La realización correcta de este ejercicio es verificada por el coordinador del estudio en cada ciudad, por campo nacional y por el departamento de crítica y codificación.

Controles en campo:

Una vez se selecciona un miembro del hogar, debe ser entrevistado así no se encuentre en ese momento. Para hacerlo el encuestador debe regresar a este hogar y realizar un nuevo intento. Este proceso se realiza dos veces, si en la segunda oportunidad no se logra contactar se hace un reemplazo de hogar.

Este procedimiento es informado y programado por el supervisor de cada grupo de encuestadores.

Dinámica de la recolección de la información

La recolección de la información será realizada por personal del Centro Nacional de Consultoría con amplia experiencia en trabajo de campo, y debidamente entrenada en el formulario a su cargo por parte de los investigadores de la Universidad de los Andes. El entrenamiento hará particular énfasis en el diligenciamiento del cuestionario de frecuencia de consumo. La muestra de sangre capilar para glucometría y hemoglobina glucosilada será colectada por una auxiliar de enfermería debidamente capacitada, y la tira y microlanceta serán depositadas en un guardián apropiadamente identificado.

Para el control de calidad de las encuestas presenciales, aleatoriamente el 10% tendrá un re-contacto telefónico para verificar la calidad de la información recolectada. Adicionalmente, el grupo de Crítica y Codificación del CNC hará revisión de la información a la totalidad de las encuestas para verificar coherencia de la información recolectada. Para el ingreso de la información se diseñará un programa de captura inteligente, y los programas de procesamiento contarán con mallas de validación que verifiquen posibles inconsistencias.

5.2 Participantes

Personas entre los 2 y 75 años, residentes de alguna de las ciudades contempladas en el diseño muestral y seleccionados para hacer parte de la muestra de estudio.

Criterios de exclusión:

- Extranjeros residiendo en Colombia.
- Personas en condición especial de alimentación (diálisis peritoneal o hemodiálisis, alimentación enteral o parenteral).
- Personas con discapacidades que les impidan responder la encuesta apropiadamente o que rehúsen a responderla.

No constituyen criterio de exclusión:

- Embarazo.
- Lactancia.

- Uso de suplementos dietarios o alimentos fortificados.
- Ser deportista de alto rendimiento.
- Alimentación condicionada por factores religiosos.
- Dieta vegetariana, vegana o restringida en algún alimento por alergia o intolerancia.
- Dieta líquida pre o posquirúrgica (el cuestionario pregunta por dieta frecuente durante *el año* anterior a su diligenciamiento).

5.3 Mediciones:

5.3.1 Variables sociodemográficas

Se colectará en todos los participantes información sobre sexo, fecha de nacimiento (edad), estrato socio-económico (SE) de la vivienda y estado laboral (empleado, independiente, pensionado, desempleado).

5.3.2 Ingesta alimentaria

Para evaluar la ingesta de alimentos y nutrientes se empleará un formulario de frecuencia de consumo semicuantitativo. Este tipo de cuestionario consta de tres partes: listado de alimentos, frecuencia de consumo y tamaño de la porción. En nuestro caso, añadiremos dos elementos más por cada ítem, a saber: i. Si se consume más frecuentemente dentro o fuera de casa y ii. Cuál es el tiempo de comida en el que se consume más frecuentemente (desayuno, media mañana, almuerzo, media tarde o cena). Los alimentos incluidos en el formulario, deben corresponder a los hábitos, cultura, preferencias y situación económica de la población donde se va a aplicar la encuesta y preferiblemente contar con un proceso de validación previo (Pérez-Rodrigo, 2013). En el estudio COPEN emplearemos un listado elaborado y publicado previamente (Monsalve, 2011), con adición de algunos ítems de interés. El tiempo requerido para diligenciar el cuestionario en pruebas piloto ha oscilado entre 30 y 50 minutos. Existe la opción de formularios abiertos para determinar hábitos y prácticas alimentarias y especialmente para incluir alimentos o bebidas nuevos, y los cerrados que facilitan el diligenciamiento, codificación y análisis, pero restringen la información recolectada (Pérez-Rodrigo, 2013). Para mejorar la calidad de la información colectada, el formulario a emplear en COPEN incluirá tres campos abiertos para ítems misceláneos no presentes en el listado, y tres para suplementos dietarios, que también se pueden diligenciar de forma abierta.

El formulario base a emplear en COPEN tiene una lista de alimentos desarrollada con base en los alimentos más frecuentemente reportados en el recordatorio de 24 horas de la ENSIN 2005. El tamaño de las porciones se estableció de acuerdo a la unidad de mayor frecuencia de ingesta por alimento y ésta se asumió como porción referencia. La frecuencia de consumo de alimentos se dividió en 9 opciones: i. Nunca, ii. 1-3 veces al mes, iii. 1 vez a la semana, iv. 2-

4 veces a la semana, v. 5-6 veces a la semana; vi. 1 vez al día, vii. 2-3 veces al día, viii. 4-6 veces al día y ix. 6 o más veces al día. El tiempo establecido para definir la ingesta usual es de un año. En un ejercicio previo de validación contra cuatro recordatorios de 24 horas independientes, una version mas corta del formulario mostró un porcentaje de clasificación en el mismo cuartil de nutriente entre 61 and 83%, y coeficientes de correlación de Pearson entre 0.51 para proteína y 0.77 para carbohidrato (Dehghan, 2012).

Si bien el cuestionario está pensado para ser auto-administrado, el participante recibirá una clara instrucción verbal sobre su diligenciamiento por parte del encuestador, quien también permanecerá en el sitio atento a posibles inquietudes que surjan. La versión adaptada del cuestionario de frecuencia de consumo se puede encontrar como Anexo 3 al proyecto.

5.3.3 Antropometría

Durante su presentación a los participantes, el encuestador establecerá un ambiente de respeto y confianza para iniciar la toma de mediciones antropométricas y solicitará la firma del ***asentimiento informado*** en menores de 2 a 13 años y el ***consentimiento informado*** por parte de los adolescentes de 14 a 18 años y adultos.

1. Se ubicarán los equipos antropométricos en un lugar plano, seguro, iluminado.
2. Previamente se habrán organizado y dispuesto los instrumentos de registro de información.
3. Se verificará la fecha de nacimiento con registro civil o tarjeta de identidad para menores de 18 años o con la cédula para participantes de o 18 más años de edad.
4. Se explicará brevemente la importancia de conocer los valores de medición peso, talla y circunferencia de la cintura y el procedimiento a seguir.

5.3.3.1 Talla

Se utilizará un tallímetro o estadiómetro portátil plegable, con base acrílica, sensibilidad de 1 mm y capacidad máxima de 205 cm (Figura 1).

Figura 1. Tallímetro o estadiómetro portátil plegable

El procedimiento para la toma de la talla se describe a continuación:

1. Se arma/desdobla el tallímetro según las instrucciones del fabricante
2. Se ubica el tallímetro en una superficie dura y plana.
3. Se pide al participante que se quite los zapatos y medias y que deshaga trenzas, peinados y retire cualquier adorno en la cabeza que pueda interferir con la medida.
4. El participante coloca los pies juntos y planos en el centro y contra la parte posterior del tallímetro.
5. Para la medición en menores de 10 años, el encuestador o un auxiliar coloca la mano derecha justo encima de los tobillos del niño, y su mano izquierda sobre las rodillas del participante, empujándolas contra el tallímetro. Las piernas deben estar rectas y los talones y las pantorrillas pegados al tallímetro.
6. El encuestador pide al participante que se mantenga recto, mirando directamente al frente, con la línea de visión y la cabeza paralelos al piso. El encuestador indica a la persona que corregirá la posición de la cabeza, y coloca su mano izquierda abierta sobre el mentón de la persona. Los hombros deben estar en posición de descanso, las manos estén rectas a lado y al lado del cuerpo.
7. Se pide al participante que haga una inspiración profunda sin levantar los hombros y bote el aire completamente; al tomar nuevamente aire el encuestador baja con su mano derecha el tope móvil superior del tallímetro hasta apoyarlo contra la cabeza, sin hacer demasiada presión (Figura 2).
8. El encuestador verifica la posición del participante y si es correcta lee en voz alta la medida en centímetros y la aproxima al milímetro (0.1 cm.) más cercano. Se registra el dato en el formulario correspondiente.
9. Se repite la medición, si hay más de 0.5 cm de diferencia entre las 2 mediciones, se realiza una tercera y se registran las 3.
10. Se limpia la base acrílica del tallímetro y se desarma el equipo.

IMAGEN

Figura 2. Puntos de contacto y posición correcta para la toma de la talla

5.3.3.2 Peso

Para la toma de peso se utilizará una balanza digital solar con sensibilidad de 100 g y capacidad de 150 kg. El kit de la balanza consta además del equipo de medición, de un morral y una linterna.

El procedimiento se describe a continuación:

1. Se pide al participante que utilice ropa liviana (por ejemplo, vestido, pantalón, pantaloneta, falda, camisa o camiseta), y que se quite los zapatos y elementos de los bolsillos como celular, billetera, monedas y llaves.
2. Se enciende la balanza y una vez marque cero (0.00) se pide al participante que suba, con los brazos a los lados del tronco y mirando hacia el frente. Se le pedirá también que coloque sus pies en la parte central de la balanza y que permanezca quieta/o antes de hacer la lectura de la pantalla.
3. Se lee en voz alta el peso en kilogramos con un (1) decimal, para que el anotador registre el valor en la casilla correspondiente.
4. Se pide al participante que baje de la balanza y cuando esta regrese a cero (00,0), se repite la toma del peso. Si hay una diferencia mayor a 100 gramos entre las dos mediciones se toma una tercera medición.
5. Se limpia la superficie del equipo con un paño húmedo se empaca en el morral, la balanza se apaga sola.

La balanza estará calibrada con una pesa de referencia (patrón) y tendrá certificado de calibración vigente según la ONAC.

Para facilitar la toma de esta medida, se ubicarán unas plantillas para indicar la posición correcta de los pies en la balanza. En el caso de niños menores de 10 años y personas mayores de 60 años el encuestador brindará apoyo / soporte para evitar accidentes al subir o bajar de la balanza. (Ver Figura 3)

IMAGEN

Figura 3. Balanza digital solar

5.3.3.3 Circunferencia de Cintura

Esta medida se tomará a todos participantes de 18 años de edad en adelante. No se tomará en mujeres en embarazo o que hayan tenido un parto en los tres meses anteriores. Se empleará una cinta métrica metálica flexible, retráctil, de lectura en mm, de 2 metros de longitud más 10 centímetros en blanco antes del 0.

Imagen

Figura 4. Cinta metálica antropométrica

El encuestador le solicitará permiso al participante para tomar la medida y explicará brevemente en qué consiste el procedimiento. Si el participante tiene zapatos altos, se le solicitará que se los quite.

El procedimiento se describe a continuación (Klein, 2007):

1. Se pide al participante que se descubra la cintura y afloje un poco su pantalón o si usa una sudadera o pantalón con resorte que lo baje un poco. La medida debe tomarse directamente sobre la piel.
2. El participante estará de pie, de frente al examinador, con los brazos a los lados del tronco para permitir que la cinta corra alrededor del abdomen.

3. Se indica al participante que distribuya el peso corporal igualmente en ambas piernas (sin recargarse en ningún lado), el abdomen relajado, los pies juntos.
4. Se traza una línea imaginaria desde el orificio de la axila hasta la cresta ilíaca anterosuperior. A nivel de esa línea se marcar un punto intermedio entre la última costilla y la cresta iliaca. A esa altura debe ubicarse la cinta métrica para la medición (Figura 5).
5. Se sostiene la cinta métrica de forma que los números queden al derecho, se coloca la cinta métrica en el punto intermedio referenciado, se lleva alrededor de la cintura y se mide la circunferencia después de una exhalación normal. **La cinta debe encontrarse completamente horizontal en todo el contorno de la cintura (paralela al piso, no debe subir ni bajar).** La cinta debe quedar justo sobre la piel (sin espacios de aire) pero no apretada.
6. En personas en quienes no sea palpable el último arco costal o la cresta iliaca, se pide al participante que, estando de pie; se incline ligeramente hacia un lado. En ese momento se formará un pliegue que servirá como punto de referencia de ese lado. La cinta debe pasar por el punto de referencia de cada lado, y por el ombligo en la parte frontal.
7. Al tomar la medida se debe mantener una distancia con la persona equivalente a la distancia extendiendo los brazos (espacio vital).
8. Es importante que el participante no haga ningún esfuerzo por sostener los músculos del abdomen (“meter la barriga”).
9. Se lee en voz alta el resultado de la medición y se anota inmediatamente en el formulario. Se repite la medida, si la diferencia entre las dos medidas es menor o igual a 1 cm se toma el promedio de esas dos medidas. Si la diferencia es mayor, se toma una tercera medida y se anota la mediana (excluyendo el valor mayor y el menor).

IMAGEN

Figura 5. Posición adecuada de la cinta métrica para determinación de la circunferencia de la cintura (Centers for Disease Control and Prevention, 2007)

5.3.4 Toma de glucometría y muestra de sangre capilar

Esta medición sólo se realizará en una sub-muestra aleatoria de pacientes adultos (18 años o mayores), que comprenderá 100 personas en Medellín, 100 en Barranquilla, 200 en Bogotá, 75 en Bucaramanga y 100 en Cali.

Los encuestadores contarán en su kit con toallitas humedecidas de alcohol, glucómetro, puncionador, lancetas, tirillas, capilares y pinzas de capilares, además de una nevera portátil. El procedimiento es el siguiente:

1. La enfermera coloca una nueva microlanceta en el puncionador.

2. La enfermera oprime el botón superior del puncionador, el botón lateral cambia al color amarillo.

3. La enfermera toma el dedo medio de la mano no dominante del participante y lo limpia con una toallita de alcohol.

5. Oprimiendo **firmemente** el puncionador sobre la cara lateral del pulpejo del dedo medio, la enfermera oprime el botón amarillo y se realiza la punción, virtualmente indolora.

6. La enfermera oprime suavemente el dedo hasta que se vea una gota de aproximadamente 3 mm de diámetro

IMAGEN

7. La enfermera pide al participante que deje el dedo en esa posición. La enfermera enciende el glucómetro, espera a que salga el ícono de introducir la tirilla e introduce la tirilla en el glucómetro, por el extremo metálico.

IMAGEN

8. Una vez la tirilla entró hasta el fondo y aparece el ícono de depositar la gota de sangre, la enfermera introduce la gota de sangre en la tirilla y espera 5 segundos a que el glucómetro arroje el resultado, que es depositado en el formulario.

IMAGEN

9. La enfermera presiona suavemente el dedo del paciente para obtener una segunda gota de sangre de 3 mm.

IMAGEN

10. La enfermera toma el tubo capilar con las pinzas provistas y lo acerca a la gota hasta que haga contacto con ella, la sangre subirá al capilar

IMAGEN

11. La enfermera deposita el capilar lleno en el tubo rojo marcado con el código del participante y agita fuertemente por 10 segundos.

12. La enfermera coloca el tubo rojo en la neverita de transporte.

13. La enfermera deposita la tira de glucometría y la microlanceta en el frasco guardián.

5.3.5 Actividad física

Como una primera aproximación somera a la asociación entre los patrones nutricionales y el nivel de actividad física, a cada participante se le solicitará diligenciar el Cuestionario Internacional de Actividad Física (IPAQ), versión de 7 preguntas (Mantilla-Toloza 2007).

5.4 Plan de análisis:

5.4.1 Ingesta dietaria

La frecuencias absolutas de consumo para cada uno de los alimentos en el cuestionario se calcularán para la muestra en su totalidad, así como para subgrupos de interés por sexo, edad y ciudad de residencia. Para cada ciudad se determinará el o los alimentos con mayor frecuencia absoluta, también los alimentos más representados dentro de cada una de las 10 categorías de alimentos. Mediante un análisis de factores - componentes principales, se explorará que alimentos representan la mayor variabilidad en la ingesta total de alimentos, y en la ingesta calórica diaria, para la muestra total y por grupos de interés.

Para la estimación de la ingesta de nutrientes se emplearán (Willett, 2013):

- Un factor de ponderación que lleva la frecuencia promedio reportada a un valor de número de porciones estándar

por día.

- En el caso de los alimentos cuya composición está definida por 100 gramos, un factor que convierte ese número de porciones estándar en un número de porciones de 100 gramos.
- Un factor de parte comestible que oscila entre 0 y 100%, y está definido en las Tablas de Composición para cada alimento.
- La composición de nutrientes del alimento según la Tabla de Composición de Alimentos Colombianos del ICBF (ICBF, 2015), o en casos en que el alimento no se encuentre en dicha tabla, empleando la información del productor o el ítem más cercano u homologable de la tabla de composición de alimentos del Departamento de Agricultura de Estados Unidos (USDA, 2018). De cada alimento se extraerán datos sobre contenido energético (Calorías), así como de macro y micronutrientes, a saber: carbohidratos, lípidos, proteína, fibra dietaria, ácidos grasos saturados, ácidos grasos monoinsaturados, ácidos grasos poliinsaturados, ácidos grasos trans, colesterol, ácido láurico, ácido miristico, ácido palmítico, ácido esteárico, ácido oleico, ácido linoleico, ácido gamma-linolénico, ácido miristoléico, ácido alfa-linolenico, ácido vaccénico, ácido eicosapentaenoico, ácido docosahexaenoico, vitamina A, vitamina E, vitamina K, vitamina D, tiamina, riboflavina, niacina, vitamina_c, folato, zinc, hierro, fósforo, calcio, sodio y potasio.

Los participantes se dividirán en cuartiles de consumo de los nutrientes de interés, y para cada nutriente si se explorará la asociación entre cuartiles de ingesta y variables sociodemográficas, estado nutricional por IMC, nivel de actividad física y presencia de estados pre-diabéticos o diabetes mellitus.

5.4.2 Antropometría

La interpretación de datos antropométricos varía según la edad del individuo, como se ha establecido para Colombia en la Resolución 2465 de 2016 (Ministerio de Salud y Protección Social, 2016). En el caso de los adultos, la definición del estado nutricional según índice de masa corporal (IMC) se definirá como Bajo peso (IMC<18.5 Kg/m^2), peso normal (IMC ≥18.5 y <25 Kg/m^2), sobrepeso (IMC ≥25 y <30 Kg/m^2) u obesidad (IMC ≥30 Kg/m^2). Para menores de edad, sin embargo, es necesario comparar a cada niño con el percentil de peso para su edad y género, talla para su edad y género o IMC para su edad y género. Las Figuras 6 y 7 resumen los puntos de corte para participantes en estos grupos de edad (INCAP, 2012).

Indicador	Punto de corte (desviaciones estándar)	Clasificación antropométrica
Talla para la Edad (T/E)	≥ -1	Talla Adecuada para la Edad.
	≥ -2 a < -1	Riesgo de Talla Baja
	< -2	Talla Baja para la Edad o Retraso en Talla
Índice de Masa Corporal para la Edad (IMC/E)**	> 3	Obesidad
	> 2 a ≤ 3	Sobrepeso
	> 1 a ≤ 2	Riesgo de Sobrepeso
	≤ 1	No Aplica (Verificar con P/T)
Peso para la Edad (P/E)**	> 1	No Aplica (Verificar con IMC/E)
	≥ -1 a ≤ 1	Peso Adecuado para la Edad
	≥ -2 a < -1	Riesgo de Desnutrición Global.
	< -2	Desnutrición Global

Figura 6. Puntos de corte para indicadores antropométricos en *menores de 5 años* en Colombia.

Indicador	Punto de corte (desviaciones estándar)	Clasificación antropométrica
Talla para la Edad (T/E)	≥ -1	Talla Adecuada para la Edad.
	≥ -2 a < -1	Riesgo de Retraso en Talla.
	< -2	Talla Baja para la Edad o Retraso en Talla.
Índice de Masa Corporal para la Edad * (IMC/E)	> 2	Obesidad
	> 1 a ≤ 2	Sobrepeso
	≥ -1 a ≤ 1	IMC Adecuado para la Edad
	≥-2 a < -1	Riesgo de Delgadez
	< -2	Delgadez

*En el Índice de Masa Corporal para la Edad, +1(DE) es equivalente a un IMC de 25 Kg/m2 a los 19 años y, +2 (DE) es equivalente a un IMC de 30 kg/m2 en la misma edad.

Figura 7. Puntos de corte para indicadores antropométricos en personas de 5 a 17 años.

En el caso de las mujeres gestantes, se utilizarán los estándares de referencia propuesto por Atalah y colaboladores (Atalah, 1997), con valores de referencia para la semana gestacional 6 a la 42 (Figura 8).

SEMANAS DE GESTACIÓN	OBESIDAD PARA LA EDAD GESTACIONAL	SOBREPESO PARA LA EDAD GESTACIONAL	IMC ADECUADO PARA LA EDAD GESTACIONAL	BAJO PESO PARA LA EDAD GESTACIONAL
6	>30.0	25.0 - 30.0	20.0 - 24.9	<20.0
7	>30.0	25.0 - 30.0	20.1 - 24.9	<20.1
8	>30.1	25.1 - 30.1	20.2 – 25.0	<20.2
9	>30.2	25.2 - 30.2	20.2 - 25.1	<20.2
10	>30.2	25.3 - 30.2	20.3 - 25.2	<20.3
11	>30.3	25.4 - 30.3	20.4 - 25.3	<20.4
12	>30.3	25.5 - 30.3	20.5 - 25.4	<20.5
13	>30.4	25.7 - 30.4	20.7 - 25.6	<20.7
14	>30.5	25.8 - 30.5	20.8 - 25.7	<20.8
15	>30.6	25.9 - 30.6	20.9 - 25.8	<20.9
16	>30.7	26.0 - 30.7	21.1 - 25.9	<21.1
17	>30.8	26.1 - 30.8	21.2 - 26.0	<21.2
18	>30.9	26.2 - 30.9	21.3 - 26.1	<21.3
19	>30.9	26.3 - 30.9	21.5 - 26.2	<21.5
20	>31.0	26.4 – 31.0	21.6 - 26.3	<21.6
21	>31.1	26.5 - 31.1	21.8 - 26.4	<21.8
22	>31.2	26.7 - 31.2	21.9 - 26.6	<21.9
23	>31.3	26.8 - 31.3	22.1 - 26.7	<22.1
24	>31.5	27.0 - 31.5	22.3 - 26.9	<22.3
25	>31.6	27.1 - 31.6	22.5 – 27.0	<22.5
26	>31.7	27.2 - 31.7	22.7 - 27.2	<22.7
27	>31.8	27.4 - 31.8	22.8 - 27.3	<22.8
28	>31.9	27.6 - 31.9	23.0 - 27.5	<23.0
29	>32.0	27.7 – 32.0	23.2 - 27.6	<23.2
30	>32.1	27.9 - 32.1	23.4 - 27.8	<23.4
31	>32.2	28.0 - 32.2	23.5 - 27.9	<23.5
32	>32.3	28.1 - 32.3	23.7 – 28.0	<23.7
33	>32.4	28.2 - 32.4	23.9 - 28.1	<23.9
34	>32.5	28.4 - 32.5	24.0 - 28.3	<24.0
35	>32.6	28.5 - 32.6	24.2 - 28.4	<24.2
36	>32.7	28.6 - 32.7	24.3 - 28.5	<24.3
37	>32.8	28.8 - 32.8	24.5 - 28.7	<24.5
38	>32.9	28.9 - 32.9	24.6 - 28.8	<24.6
39	>33.0	29.0 - 33.0	24.8 - 28.9	<24.8
40	>33.1	29.2 - 33.1	25.0 - 29.1	<25.0
41	>33.2	29.3 - 33.2	25.1 - 29.2	<25.1
42	>33.2	29.3 - 33.2	25.1 - 29.2	<25.1

Figura 8. Clasificación antropométrica de las gestantes según IMC por semanas de gestación (Atalah, 1997)

5.5 Aspectos éticos

Los participantes proveerán un documento de consentimiento: ***Asentimiento informado*** que señala la voluntad de cooperación del niño o de la niña en menores de 2 a 13 años y ***consentimiento informado*** por parte de los adolescentes de 14 a 18 años y adultos.

El consentimiento informado explica los objetivos del estudio, los procedimientos, riesgos, compromisos y beneficios individuales y colectivos de participar y de realizar este estudio. Además, expresa claramente que la participación es voluntaria, la confidencialidad de os datos y el derecho a negarse o retirarse de estudio sin que ello acarree ninguna consecuencia negativa.

A los participantes en situaciones que ameriten atención en salud se exhortará a acudir a sus centros de atención en salud. La información recolectada quedará bajo responsabilidad de la Universidad de los Andes, el Centro Nacional de Consultoría y Team Foods, quienes deberán garantizar la confidencialidad de los participantes.

El estudio se presentará para el aval de un comité de ética y de investigaciones de la Universidad de los Andes, y si ellos así lo sugieren, también a un Comité de Ética externo a la institución.

6. Cronograma:

ACTIVIDAD	2018					
	Jul	Ago	Sep	Oct	Nov	Dic
Análisis jurídico de implicaciones de estudio y firma de acuerdo jurídico						
Aplicación a Comité de Ética						
Elaboración de instructivos y capacitación a encuestadores y auxiliares de enfermería						
Estudio piloto y ajustes de metodología						
Ejecución del estudio en campo						
Digitalización de datos						
Análisis de datos						
Elaboración de informe final						

7. Presupuesto (Componente a ejecutar por UniAndes):

ITEM	Costo / hora	Dedicación semanal (horas)	Número de semanas	Subtotal
Personal científico - Director científico	$ 166.667	10	24	$ 40.000.000
Personal científico - Epidemióloga	$ 125.000	8	20	$ 20.000.000
Personal científico - Salubrista pública	$ 125.000	8	20	$ 20.000.000
Costo total ejecución				$ 80.000.000
Overhead UniAndes - Contribución a gastos generales (33% del costo total del proyecto)				$ 40.000.000
Costo total del estudio (componente UniAndes)				$ 120.000.000

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Anexo 1. Formato de consentimiento informado

Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018

Información para consentimiento informado

Señor (a) _____

Queremos invitarlo a usted a participar voluntariamente en el "**Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018**" cuyo objetivo es estimar la ingesta habitual de alimentos y nutrientes en residentes de las cinco principales ciudades de Colombia: Bogotá, Cali, Medellín, Barranquilla y Bucaramanga. También, con el estudio buscamos explorar los factores que se asocian al consumo de unos u otros alimentos en la población del país, y la manera como esos hábitos de alimentación se asocian con el estado de la nutrición y con la manera en que el cuerpo maneja los azúcares.

A continuación leeremos la información necesaria para que usted pueda decidir si desea participar en el estudio, le solicitamos el favor de escuchar cuidadosamente y hacer todas las preguntas que desee antes de informarnos su decisión.

Cada persona tiene unos hábitos de alimentación diferentes, que influyen muchísimo en su salud y en muchos aspectos de su vida diaria. A pesar de su importancia, en Colombia tenemos muy poca información sobre lo que comemos en general y en las diferentes zonas del país, los hombres y las mujeres, las personas más jóvenes o más mayores, etc.

¿Qué queremos hacer?

El grupo de investigación está interesado en recolectar información sobre el consumo de 150 alimentos diferentes en nuestra población, clasificados en 10 grupos diferentes, y sobre la asociación del consumo de esos alimentos con otras características de la población. El estudio COPEN es realizado en conjunto por la Universidad de los Andes, el Centro Nacional de Consultoría y Team Foods.

¿Cómo haremos la Encuesta y cómo sería su participación en ella?

1. Un encuestador y una enfermera auxiliar debidamente capacitados recolectarán la información.
2. Pedimos su autorización, por escrito, para participar en éste estudio. Dicha autorización incluye: realización de un cuestionario de frecuencia de consumo de alimentos, toma de peso, talla, perímetro de la cintura y toma de una muy pequeña muestra de sangre capilar (del dedo).
3. El resultado de la glucometría de sangre capilar la conocerá inmediatamente, el resultado de la hemoglobina glucosilada (un estudio más avanzado para saber si el cuerpo tiene diabetes) se adelantará en la Universidad de los Andes.

Que riesgos representa su participación en el estudio?

La toma de una muestra de sangre capilar y representa un mínimo riesgo por dolor, morado o hinchazón en el sitio de la punción, que generalmente no se presenta. Es mucho más sencillo que una muestra de sangre habitual y es casi indolora.

Que beneficios tendrá por su participación en el estudio?

Usted no incurrirá en gastos por concepto de las pruebas que se realicen, los resultados de glucometría serán entregados inmediatamente y las muestras tomadas no serán utilizadas para ningún otro estudio sin su consentimiento.

Derechos de los participantes

Su participación es completamente libre y voluntaria, aún si usted acepta, puede retirarse voluntariamente del estudio en cualquier momento. Toda la información recolectada será guardada en forma confidencial y anónima. Sólo el personal a cargo del estudio tendrá acceso para fines de análisis y exclusivamente con carácter poblacional.

Personas que pueden darle información adicional

Si usted ahora o en cualquier otro momento desea hacer una consulta sobre el estudio, puede contactar a las siguientes personas:

Dr. Carlos O Mendivil, Profesor Asociado Universidad de los Andes.
Teléfono: (1) 339.4949 Ext. 3803, 3780 o 1248. Email: carlosolimpo@gmail.com

Comité de Ética de la Universidad de los Andes
Teléfono (1) 339.4949 ext. 5339 o 3211. Email: comite-etica-investigaciones@uniandes.edu.co.

Eddy Carolina Betancourt, Investigadora en Nutrición, Team Foods.
Teléfono: (1) 770 9000 Email: eddy.betancourt@gmail.com

Declaración de consentimiento informado
Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018

Si usted autoriza su participación en este estudio, por favor complete los siguientes datos:

Yo, _____, Identificado con CC _____de_____ autorizo mi participación en el "**Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018**" y declaro que se me ha leído y explicado detalladamente la información del consentimiento informado y que he comprendido los objetivos, los procedimientos y demás aspectos relacionados con este y que tuve la posibilidad de hacer preguntas para aclarar mis dudas.

Declaro que mi participación en este estudio es voluntaria, que colaboraré en lo que pueda y que podré retirarme cuando así lo decida. La información que suministre será cierta, solo se me entregarán los resultados de la glucometría, los demás serán analizados de forma confidencial y con carácter poblacional.

En constancia, firmo a continuación:
Nombre: _____
Firma: _____
Fecha: _____

Testigo 1:

Nombre: _____
Relación: _____
Firma: _____

Testigo 2:

Nombre: _____
Relación: _____
Firma: _____

Nombre completo del profesional que obtuvo el consentimiento:
_____

Firma del profesional que obtuvo el consentimiento:
_____

Anexo 2. Formato de Asentimiento informado

Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018

Información para Asentimiento Informado

Señor (a) _____

Queremos invitarlo a usted a participar voluntariamente en el "**Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018**" cuyo objetivo es estimar la ingesta habitual de alimentos y nutrientes en residentes de las cinco principales ciudades de Colombia: Bogotá, Cali, Medellín, Barranquilla y Bucaramanga. También, con el estudio buscamos explorar los factores que se asocian al consumo de unos u otros alimentos en la población del país, y la manera como esos hábitos de alimentación se asocian con el estado de la nutrición y con la manera en que el cuerpo maneja los azúcares.

A continuación leeremos la información necesaria para que usted pueda decidir si desea participar en el estudio, le solicitamos el favor de escuchar cuidadosamente y hacer todas las preguntas que desee antes de informarnos su decisión.

Cada persona tiene unos hábitos de alimentación diferentes, que influyen muchísimo en su salud y en muchos aspectos de su vida diaria. A pesar de su importancia, en Colombia tenemos muy poca información sobre lo que comemos en general y en las diferentes zonas del país, los hombres y las mujeres, las personas más jóvenes o más mayores, etc.

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El grupo de investigación está interesado en recolectar información sobre el consumo de 150 alimentos diferentes en nuestra población, clasificados en 10 grupos diferentes, y sobre la asociación del consumo de esos alimentos con otras características de la población. El estudio COPEN es realizado en conjunto por la Universidad de los Andes, el Centro Nacional de Consultoría y Team Foods.

¿Cómo haremos la Encuesta y cómo sería su participación en ella?

1. Un encuestador y una enfermera auxiliar debidamente capacitados recolectarán la información.
2. Pedimos su autorización, por escrito, para participar en éste estudio. Dicha autorización incluye: realización de un cuestionario de frecuencia de consumo de alimentos, toma de peso, talla, perímetro de la cintura y toma de una muy pequeña muestra de sangre capilar (del dedo).
3. El resultado de la glucometría de sangre capilar la conocerá inmediatamente, el resultado de la hemoglobina glucosilada (un estudio más avanzado para saber si el cuerpo tiene diabetes) se adelantará en la Universidad de los Andes.

Que riesgos representa su participación en el estudio?

La toma de una muestra de sangre capilar y representa un mínimo riesgo por dolor, morado o hinchazón en el sitio de la punción, que generalmente no se presenta. Es mucho más sencillo que una muestra de sangre habitual y es casi indolora.

Que beneficios tendrá por su participación en el estudio?

Usted no incurrirá en gastos por concepto de las pruebas que se realicen, los resultados de glucometría serán entregados inmediatamente y las muestras tomadas no serán utilizadas para ningún otro estudio sin su consentimiento.

Derechos de los participantes

Su participación es completamente libre y voluntaria, aún si usted acepta, puede retirarse voluntariamente del estudio en cualquier momento. Toda la información recolectada será guardada en forma confidencial y anónima. Sólo el personal a cargo del estudio tendrá acceso para fines de análisis y exclusivamente con carácter poblacional.

Personas que pueden darle información adicional

Si usted ahora o en cualquier otro momento desea hacer una consulta sobre el estudio, puede contactar a las siguientes personas:

Dr. Carlos O Mendivil, Profesor Asociado Universidad de los Andes.
Teléfono: (1) 339.4949 Ext. 3803, 3780 o 1248. Email: carlosolimpo@gmail.com

Comité de Ética de la Universidad de los Andes
Teléfono (1) 339.4949 ext. 5339 o 3211. Email: comite-etica-investigaciones@uniandes.edu.co.

Eddy Carolina Betancourt, Investigadora en Nutrición, Team Foods.
Teléfono: (1) 770 9000 Email: ebetancourt@team.co

Declaración de Asentimiento Informado
Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018

Si usted autoriza su participación en este estudio, por favor complete los siguientes datos:

Yo, _____, Identificado con CC:_____, en calidad de_____ autorizo la participación del niño(a)_____en el "**Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018**" y declaro que se me ha leído y explicado detalladamente la información del Asentimiento informado y que he comprendido los objetivos, los procedimientos y demás aspectos relacionados con este y que tuve la posibilidad de hacer preguntas para aclarar mis dudas.

Declaro que la participación en este estudio es voluntaria, que colaboraré en lo que pueda y que podré retirar al niño (a) cuando así lo decida. La información que suministre será cierta, solo me entregarán los resultados de glucometría, los demás serán analizados de forma confidencial y con carácter poblacional.

En constancia, firmo a continuación:
Nombre: _____
Firma: _____
Fecha: _____

Testigo 1:
Nombre: _____
Relación: _____
Firma: _____

Testigo 2:
Nombre: _____
Relación: _____
Firma: _____

Nombre completo del profesional que obtuvo el asentimiento:
_____

Firma del profesional que obtuvo el asentimiento:
_____

Bogotá, septiembre de 2018

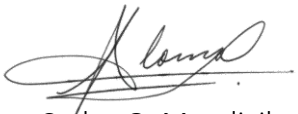
Muy buenos días,

La Universidad de los Andes viene adelantando el estudio COPEN (estudio colombiano de perfiles nutricionales), con el fin de conocer qué alimentos se comen en Colombia, y cómo cambian los hábitos alimentarios en diferentes regiones del país, por sexo y por edades. El estudio se viene adelantando en asocio con el Centro Nacional de Consultoría en 5 ciudades de Colombia: Bogotá, Medellín, Cali, Barranquilla y Bucaramanga.

También vamos a estudiar la asociación entre hábitos de alimentación y estado nutricional, además de los niveles de azúcar en la sangre para conocer el riesgo de diabetes. A usted le dejaremos un pequeño reporte con sus datos, y los resultados de todo el estudio completo servirán para conocer mejor la situación nutricional en Colombia y en sus principales ciudades.

Su participación será de gran importancia para el país, valoramos y agradecemos que nos regale este tiempo.

Cordialmente,



Carlos O. Mendivil
Investigador Principal
Estudio COPEN

Facultad de Medicina
Carrera 1 N° 18 A – 10 Bloque Q, 8vo piso - Bogotá, Colombia | Tel. (57.1) 332 4282 | Fax. (57.1) 332 4281
medicina.uniandes.edu.co | e-mail: facmedicina@uniandes.edu.co

Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018	*Centro Nacional de Consultoría Ltda.* *Calle 82 No. 6- 51* *Teléfono: 339 4888*	PERFILES NUTRICIONALES Frecuencia de consumo
Centro de Costos: 4098_01	Fecha: 3 de septiembre de 2018 Versión Final	Prueba piloto : SI
Elaborado por: Dr. Carlos O Mendivil Profesor Asociado Angélica Montaño, ND, Esp UNIVERSIDAD DE LOS ANDES	Revisado por: Alejandra Campuzano CENTRO NACIONAL DE CONSULTORÍA Eddy Carolina Betancourt Villamizar TEAM	Revisado en Campo por: Gladys Muñoz CENTRO NACIONAL DE CONSULTORÍA

Saludo al Informante. Muy buenos días/ tardes/ noches (Nombre del informante). Mi nombre es (nombre y apellido) del **Centro Nacional de Consultoría**, una empresa privada dedicada a la investigación de mercados, social y de opinión pública. Actualmente adelantamos un estudio para evaluar el consumo de alimentos en residentes de cinco ciudades del país, además de conocer el estado nutricional y posible riesgo de diabetes.

Su participación es voluntaria y en atención a la ley sobre tratamiento de datos personales, su identidad y sus respuestas son de carácter confidencial y se utilizarán únicamente con fines estadísticos, como lo establece nuestra política de datos.

Iniciación Hora /__/__/ minutos **/__/__/**

PERFIL DEMOGRÁFICO

ENC: SI EL ENTREVISTADO TIENE OBJECIÓN O REPAROS EN FACILITAR DATOS RECUERDELE QUE "éstos son sólo utilizados con propósitos estadísticos".

DATOS DEL SELECCIONADO	
Nombre completo el entrevistado:	
Dirección :	Teléfono de contacto:
Fecha de nacimiento: (dd/mm/aaaa)	Edad:

DATOS DEL CIUDADOR – DEL RESPONSABLE DEL MENOR DE 13 AÑOS	
Nombre completo del cuidador:	
Parentesco con el menor	Teléfono de contacto:

ENC: NO LEER OPCIONES DE RESPUESTA- ESPONTÁNEO

A. SEXO		B. CIUDAD		C. OCUPACIÓN PRINCIPAL		D. NIVEL EDUCATIVO ALCANZADO	
Hombre	1	Bogotá	1	Empleado(a) tiempo completo	1	Pre- escolar	1
Mujer	2	Medellín	2	Empleado(a) tiempo parcial	2	Primaria	2
E. ESTRATO (Por cartografía)		Cali	3	Independiente – Trabaja por cuenta propia	3	Secundaria	3
Uno	1	Barranquilla	4	Empresario	4	Técnico	4
Dos	2	Bucaramanga	5	Buscando Empleo	5	Tecnológico	5
Tres	3	**F. ESTADO CIVIL**		Jubilado, pensionado	6	Universitario	6
Cuatro	4	Soltero	1	Estudiante	7	Postgrado (especialización, maestría, doctorado)	7
Cinco	5	Casado / vive en pareja/ unión libre	2	Me dedico tiempo completo a labores del Hogar	8	Sin estudios	8
Seis	6	Viudo / separado / divorciado	3	Menor en casa	9		
NS/NR	9	Se rehúsa	4				

ENC: SIGUIENTES PREGUNTAS SOLO APLICAN PARA MUJERES

E. ¿Se encuentra en estado de embarazo? SI____1 CONTINUA CON F NO____2 PASE A INSTRUCCIÓN ANTES DE CATEGORIA LACTEOS
F. Mes de gestación: _____ (SI MENCIONA EN SEMANAS APROXIME AL MES)
G. Fecha de la última menstruación: (dd/mm/aaaa)
ENC: SI LA PARTICIPANTE ES GESTANTE, DEBE QUEDAR DILIGENCIADO AL MENOS UNO DE LOS DOS CAMPOS F O G

ENCUESTADOR LEA:

A CONTINUACION PREGUNTAMOS POR UNAS CATEGORIAS DE ALIMENTOS, PARA CADA UNO DE ELLAS POR FAVOR RESPONDA DE ACUERDO A SUS HÁBITOS DEL ÚLTIMO AÑO / ULTIMOS 12 MESES LA FRECUENCIA, EL LUGAR Y MOMENTO DE CONSUMO.

ENCUESTADOR RECUERDE PARA TODA LA ENCUESTA:

1. POR FAVOR LEA AL ENCUESTADO CADA CATEGORIA ALIMENTOS: " PIENSE EN EL HABITOS DE CONSUMO EN LOS ULTIMOS 12 MESES "
2. MUESTRE TARJETAS DE PORCIONES PARA QUE EL ENCUESTADO TENGA UNA REFERENCIA VISUAL EN EL DESARROLLO DE LA ENCUESTA, EN CASO QUE EL ENCUESTADO REQUIERA VERLA NUEVAMENTE FACILITE TARJETA DE PROCIONES
3. PARA LA PREGUNTA B CANTIDAD APROXIME SIEMPRE A NUMERO ENTERO EJEMPLO ½ a 1. Y RECUERDE TENER EN CONSIDERACION SIEMPRE LA PORCION EJ: CRUSTÁCEOS, CAMARONES, LANGOSTINOS (4 O 5 PIEZAS) SI CONSUME ESAS PIEZAS EN CANTIDAD ES 1 NO 5 PORCIONES.
4. PARA LA PREGUNTA C LUGAR DE CONSUMO RECUERDE:
   a. SI EL ALIMENTO ES PREPARADO EN LA CASA Y SE CONSUME DENTRO O FUERA, SE ASOCIA A "CONSUMO EN CASA" Y SI SE PREPARÓ FUERA (RESTAURANTE, CAFETERÍA, HOTEL, AVIÓN, TIENDA, CENTRO COMERCIAL, ETC) SE ASOCIA A "CONSUMO FUERA DE CASA"
   b. SI EL ALIMENTO ES INDUSTRIALIZADO O NO REQUIERE NINGUN TIPO DE PREPARACION (YOGURT,QUESOS, SALCHICON, FRUTAS ENTRE OTROS) LA RESPUESTA SE ASOCIA AL LUGAR DE CONSUMO O INGESTA DEL ALIMENTO.

CATEGORIA: LÁCTEOS

ENCUESTADOR LEA: "PENSANDO EN LOS HABITOS DE CONSUMO DE LACTEOS EN LOS ULTIMOS 12 MESES POR FAVOR RESPONDA LAS SIGUIENTES PREGUNTAS - PIENSE EN TODAS LAS PREPARACIONES EN LAS CUALES SE ADICIONA LECHE EJ: CAFÉ, CHOCOLATE, JUGOS

A. ¿Con qué frecuencia usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA ESCALA Y ENTREGUE TARJETA NO. 1) – RESPUESTA ÚNICA)
B. Cada vez que consume ___ __(REEEMPLACE POR PORCION Y ALIMENTO)? ¿Cuánto consume? (ESPONTÁNEA – REGISTRE DATO EXACTO SUMINISTRADO POR EL ENCUESTADO – APROXIME AL SIGUIENTE ENTERO-)
C. ¿ Donde usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
D. ¿En qué momento del día consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES Y ENTREGUE TARJETA NO. 2) RESPUESTA ÚNICA

				A. Consumo promedio durante el último año									B. Cantidad	C. Lugar de consumo		D. Lo consume más frecuentemente al:				
						Veces por Semana			Veces al día											
Ítem	Alimento (LEER)	Porción (LEER)	Tamaño porción	Nunca o casi nunca	1 a 3 veces / mes	1	2-4	5-6	1	2-3	4-6	Más de 6		En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cena
1	Leche de vaca (entera)	1 vaso pequeño	150 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
2	Leche de vaca (semidescremada o deslactosada)	1 vaso pequeño	150 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
3	Leche de vaca (descremada)	1 vaso pequeño	150 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
4	Leche en polvo entera	1 cucharada llena	15 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
5	Leche en polvo descremada	1 cucharada dulcera llena	6 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

6	Yoghurt o kumis entero (cremoso) Tarjeta sin pensar en marca		200 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
7	Yoghurt o kumis light (cremoso)		200 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
8	Cuajada	1 tajada delgada	28 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
9	Queso crema para untar	1 cucharada tintera alta	6 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
10	Queso Mozzarella (Pera o doblecrema)	1 tajada delgada	28 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
11	Queso duro (Costeño, Holandés, parmesano, paipa)	1 tajada delgada	28 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
12	Queso blanco o fresco (Campesino)	1 tajada delgada	28 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
13	Queso lonchita (Amarillo, cortado)	una unidad	24 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
ENCUESTADOR RECUERDE: OTROS ALIMENTOS NO INCLUIDOS – MOSTRAR TARJETA Y REGISTRAR LAS DOS OPCIONES MAS FRECUENTES																				
	¿Algún otro alimento no incluido? ____			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
	¿Algún otro alimento no incluido? ____			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CATÉGORIA: HUEVOS, CARNES Y PESCADOS

ENCUESTADOR LEA: "PENSANDO EN LOS HÁBITOS DE CONSUMO DE HUEVOS, CARNES Y PESCADOS EN LOS ULTIMOS 12 MESES POR FAVOR RESPONDA LAS SIGUIENTES PREGUNTAS"

A. ¿Con qué frecuencia usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA ESCALA Y ENTREGUE TARJETA NO. 1) – RESPUESTA ÚNICA)
B. Cada vez que consume ___ __(REEMPLACE POR PORCION Y ALIMENTO)? ¿Cuánto consume? (ESPONTÁNEA – REGISTRE DATO EXACTO SUMINISTRADO POR EL ENCUESTADO)
C. ¿ Donde usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
D. ¿En qué momento del día consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES Y ENTREGUE TARJETA NO. 2) RESPUESTA ÚNICA

Ítem	Alimento	Porción	Tamaño porción	A. Consumo promedio durante el año anterior									B. Cantidad	C. Lugar de consumo		D. Lo consume más frecuentemente al:				
				Nunca o casi nunca	1 a 3 veces / mes	Veces por semana			Veces al día					En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cena
						1	2-4	5-6	1	2-3	4-6	Más de 6								
14	Huevo de gallina	1		0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
15	Pollo con piel	1 ración o pieza		0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
16	Pollo sin piel	1 ración o pieza		0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
17	Carne de res	1 ración pequeña	60 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
18	Carne de cerdo	1 ración pequeña	60 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
19	Chicharron	1 ración pequeña	60 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
20	Hígado de res, cerdo o pollo	1 ración Pequeña	60 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
21	Otras vísceras de res (sesos, corazón)	1 ración		0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
22	Chorizo	1 unidad mediana	30 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
23	Salchichón	1 tajada	50 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
24	Morcilla	1 unidad	60 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
25	Mortadela	1 unidad	34 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
26	Salchicha	1 unidad Pequeña	25 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
27	Carne de Hamburguesa	1 unidad	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
28	Bagre	1 filete	80 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
29	Trucha	1 filete	80 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
30	Tilapia	1 filete	80 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
31	Salmon	1 filete	80 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
32	Ostras, ostiones, almejas, mejillones y similares	6 unidades		0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
33	Calamares o Pulpo	1 ración	200 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
34	Crustáceos, camarones,	4 o 5 piezas	200 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

	langostinos																			
35	Pescados enlatados en agua (sardinas o atún)	1 lata pequeña	80 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
36	Pescados enlatados en aceite (sardinas o atún)	1 lata pequeña	80 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
ENCUESTADOR RECUERDE: OTROS ALIMENTOS NO INCLUIDOS – MOSTRAR TARJETA Y REGISTRAR LAS DOS OPCIONES MAS FRECUENTES																				
	¿Algún otro alimento no incluido? ____			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
	¿Algún otro alimento no incluido? ____			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CATEGORIA: LEGUMINOSAS Y HARINAS

ENCUESTADOR LEA: "PENSANDO EN LOS HABITOS DE CONSUMO DE LEGUIMINOSAS Y HARINAS EN LOS ULTIMOS 12 MESES POR FAVOR RESPONDA LAS SIGUIENTES PREGUNTAS"

A. ¿Con qué frecuencia usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA ESCALA Y ENTREGUE TARJETA NO. 1) – RESPUESTA ÚNICA)
B. Cada vez que consume ___ __(REEEMPLACE POR PORCION Y ALIMENTO)? ¿Cuánto consume? (ESPONTÁNEA – REGISTRE DATO EXACTO SUMINISTRADO POR EL ENCUESTADO)
C. ¿ Donde usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
D. ¿En qué momento del día consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES Y ENTREGUE TARJETA NO. 2) RESPUESTA ÚNICA

				A. Consumo promedio durante el año anterior									B. Cantidad	C. Lugar de consumo		D Lo consume más frecuentemente al:				
						Veces por semana			Veces al día											
Ítem	Alimento	Porción	Tamaño porción	Nunca o casi nunca	1 a 3 veces / mes	1	2-4	5-6	1	2-3	4-6	Más de 6		En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cena
37	Lentejas	1 cucharón mediano	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
38	Fríjol	1cucharón mediano	100g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
39	Garbanzos o arveja seca	1 cucharón Mediano	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
40	Soya	1 cucharón Mediano	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
41	Tostadas	1 unidad	32 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
42	Pan blanco (pan tajado o de panadería)	1 pan o 2 tajadas de pan	50 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
43	Pan integral (pan tajado o de panadería)	1 pan o 2 tajadas de pan	50 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
44	Almojábana, pan de bono o pan de queso, pan de yuca	1 unidad mediana	60 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
45	Buñuelo	1 unidad Pequeña	70 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
46	Empanada	1 unidad	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
47	Pastel de pollo o			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

	pastel de carne	1 unidad	140 g																	
48	Papa rellena	1 unidad	130 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
49	Hojaldre de sal (Pastel de queso, jamón o Hawaiano	1 unidad	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
50	Galletas de sal (Saltín, dux, club social)	1 paquete Individual	25 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
51	Cereales de caja (müesli, all-bran, granola)	1 pocillo	60 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
52	Avena Hojuelas	4 cucharas	24 g																	
53	Arepa tela (Extra-delgada de maíz, blanca y sin relleno)	1 unidad	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
54	Mazorca fresca o maíz tierno enlatado	1 unidad	82 g (1/2pocillo)	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
55	Arroz cocido	1 pocillo	130 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
56	Pasta (fideos, macarrones, espaghetti u Otros)	1 porción Mediana	120 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
57	Pizza/ panzerotti	1 porción	200 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
58	Plátano verde o maduro	1 trozo Mediano	90 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
59	Papa	1 papa mediana (o 3 criollas pequeñas)	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
60	Yuca, ñame, malanga y batata	1 trozo Mediano	62 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
61	Arracacha	1 trozo Mediano	62 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
ENCUESTADOR RECUERDE: OTROS ALIMENTOS NO INCLUIDOS – MOSTRAR TARJETA Y REGISTRAR LAS DOS OPCIONES MÁS FRECUENTES																				
	¿Algún otro alimento no incluido? ____			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
	¿Algún otro alimento no incluido? ____			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CATEGORIA: FRUTAS , VERDURAS Y HORTALIZAS

ENCUESTADOR LEA: "PENSANDO EN LOS HABITOS DE CONSUMO DE FRUTAS Y VEGETALES EN LOS ULTIMOS 12 MESES POR FAVOR RESPONDA LAS SIGUIENTES PREGUNTAS":

A. ¿Con qué frecuencia usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA ESCALA Y ENTREGUE TARJETA NO. 1) – RESPUESTA ÚNICA)
B. Cada vez que consume ____ __(REEEMPLACE POR PORCION Y ALIMENTO)? ¿Cuánto consume? (ESPONTÁNEA – REGISTRE DATO EXACTO SUMINISTRADO POR EL ENCUESTADO)
C. ¿ Donde usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
D. ¿En qué momento del día consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES Y ENTREGUE TARJETA NO. 2) RESPUESTA ÚNICA

				A. Consumo promedio durante el año anterior									B. Cantidad	C. Lugar de consumo		D. Lo consume más frecuentemente al:				
						Veces por semana			Veces al día											
Ítem	Alimento	Porción	Tamaño porción	Nunca o casi nunca	1 a 3 veces / mes	1	2-4	5-6	1	2-3	4-6	Más de 6		En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cena
PARA FURTAS: PIENSE PÓR PORCION DE FRUTA ENTERA NO JUGO, DULCES O POSTRES																				
62	Naranja	1 unidad pequeña	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
63	Mandarina	1 unidad pequeña	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
64	Banano	1 unidad pequeña	85 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
65	Manzana o pera con cáscara	1 unidad	120 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
66	Fresas	6 unidades	80 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
67	Sandía, melón o piña	1 tajada	125 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
68	Papaya	1 tajada	125 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
69	Uvas rojas o Verdes	10 unidades	70 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
70	Mango	1 unidad Mediana/ 1 tajada	120 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
71	Guanábana, anón, chirimoya, guama	2 cucharadas soperas	32 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
72	Granadilla	1 unidad	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
PARA VERDURAS Y HORTALIZAS PIENSE EN LAS SIGUIENTES PREPARACIONES ENSALADAS, SOPAS, GUISOS Y TORTA																				
73	Espinaca	1 pocillo	50 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
74	Col, coliflor o Brócoli	1/2 pocillo	40 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
75	Lechuga	1 pocillo	50 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
76	Repollo	1/2 pocillo	35 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
77	Tomate rojo	1 mediano (3 Cherry)	65 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
78	Tomate verde	4 rodajas	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
79	Zanahoria	1/4 de unidad	30 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

80	Remolacha	1/4 de unidad	30 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
81	Pepino cohombro o de ensalada	1/2 unidad	60 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
82	Cebolla cabezona blanca o roja	1/4 unidad (3 cucharada soperas)	30 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
83	Setas, hongos o champiñones	1/2 pocillo	30 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
84	Ahuyama	1 trozo	68 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
85	Arveja verde	1/2 pocillo	50g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
86	Habichuela	1/2 pocillo	37g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
87	Perejil, tomillo, laurel, orégano, cilantro, hierbabuena	1 pizca		0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
88	Verduras enlatadas	1/4 lata	75 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
89	Frutos secos (maní, almendra o nueces, pistachos)	1 paquete	50g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
ENCUESTADOR RECUERDE: OTROS ALIMENTOS NO INCLUIDOS – MOSTRAR TARJETA Y REGISTRAR LAS DOS OPCIONES MÁS FRECUENTES																				
	¿Algún otro alimento no incluido? ____			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
	¿Algún otro alimento no incluido? ____			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CATEGORIA: ACEITES Y GRASAS

ENCUESTADOR LEA: "PENSANDO EN LOS HABITOS DE CONSUMO DE ACEITES Y GRASAS EN LOS ULTIMOS 12 MESES POR FAVOR RESPONDA LAS SIGUIENTES PREGUNTAS" PIENESE EN LAS PREPARACIONES EN LAS CUALES SE ADICIONA ACIETES Y GRASAS Ej: FRITOS, ENSALADAS, CARNES, POLLO, PESCADO FRITO

A. ¿Con qué frecuencia usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA ESCALA Y ENTREGUE TARJETA NO. 1) – RESPUESTA ÚNICA)
B. Cada vez que consume ___ __(REEEMPLACE POR PORCION Y ALIMENTO)? ¿Cuánto consume? (ESPONTÁNEA – REGISTRE DATO EXACTO SUMINISTRADO POR EL ENCUESTADO)
C. ¿ Donde usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
D. ¿En qué momento del día consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES Y ENTREGUE TARJETA NO. 2) RESPUESTA ÚNICA

				A. Consumo promedio durante el año anterior								B. Cantidad	c. Lugar de consumo		D. Lo consume más frecuentemente al:				
						Veces por semana			Veces al día										
Ítem	Alimento	Porción	Tamaño porción	Nunca o casi nunca	1 a 3 veces / mes	1	2-4	5-6	1	2-3	4-6	Más de 6		En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cena
90	Aceite de oliva	1 cucharada	15 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
91	Aceite de maíz	1 cucharada	15 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
92	Aceite de girasol	1 cucharada	15 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
93	Aceite de soya	1 cucharada	15 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
94	Aceite de canola	1 cucharada sopera	15 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
95	Aceite de palma	1 cucharada	15 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
96	Aceite de coco	1 cucharada	15 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
97	Aguacate (Tradicional o Hass negro)	1/4 de Unidad ½ Hass	120 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
98	Margarina de mesa esparcible	1 cucharadita	5 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
99	Mantequilla	1 cucharadita	5 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
100	Margarina de cocina o en barra	1 cucharada sopera	15 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
101	Manteca de Cerdo	1 cucharada sopera	15 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
ENCUESTADOR RECUERDE: OTROS ALIMENTOS NO INCLUIDOS – MOSTRAR TARJETA Y REGISTRAR LAS DOS OPCIONES MÁS FRECUENTES																				
	¿Algún otro alimento no incluido? ____			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
	¿Algún otro alimento no incluido? ____			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CATEGORIA: DULCES Y POSTRES

ENCUESTADOR LEA: "PENSANDO EN LOS HABITOS DE CONSUMO DE AZUCARES EN LOS ULTIMOS 12 MESES POR FAVOR RESPONDA LAS SIGUIENTES PREGUNTAS"

A. ¿Con qué frecuencia usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA ESCALA Y ENTREGUE TARJETA NO. 1) – RESPUESTA ÚNICA)
B. Cada vez que consume ___ __(REEEMPLACE POR PORCION Y ALIMENTO)? ¿Cuánto consume? (ESPONTÁNEA – REGISTRE DATO EXACTO SUMINISTRADO POR EL ENCUESTADO)
C. ¿ Donde usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
D. ¿En qué momento del día consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES Y ENTREGUE TARJETA NO. 2) RESPUESTA ÚNICA

				A. Consumo promedio durante el año anterior									B. Cantidad	C. Lugar de consumo		D. Lo consume más frecuentemente al:				
						Veces por semana			Veces al día											
Ítem	Alimento	Porción	Tamaño porción	Nunca o casi nunca	1 a 3 veces / mes	1	2-4	5-6	1	2-3	4-6	Más de 6		En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cena
102	Dulces de leche Arequipe / Panelita	1 cucharada sopera/1 unidad	20 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
103	Bocadillo	1 unidad	25 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
104	Chocolatina	1 unidad Pequeña	12 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
105	Galletas dulces	1 paquete		0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
106	Hojaldres dulces (Pastel gloria, pasabocas, corazones)	1 unidad	90 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
107	Torta dulce o ponque (Chocolate, frutas, verduras)	1 porción	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
108	Donuts Industrializadas	1 unidad	50 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
109	Churros azucarados o Rellenos	1 unidad	100 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
110	Brownie	1 unidad	65 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
111	Helado	1 bola pequeña	45 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
112	Caramelos, dulces Confites	1 unidad	10 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
113	Mermelada	1 cucharada	15 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
114	Leche condensada	2 cucharadas	28 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
115	Azúcar morena o blanca	1 cucharada tintera o un sobre	5 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
116	Azúcar light	1 cucharada tintera o un sobre	5 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

117	Endulzantes no calóricos tipo sabro, splenda o Stevia	1 sobre o 1 tableta		0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
118	Paquetes snack (papitas, platanitos, Rosquitas etc)	1 paquete	30g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
ENCUESTADOR RECUERDE: OTROS ALIMENTOS NO INCLUIDOS LA RESPUESTA ES ESPONTÁNEA EN CASO DE NO RESPUESTA MUESTRE TARJETA																				
	¿Algún otro alimento no incluido? ____			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
	¿Algún otro alimento no incluido? ____			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CATEGORIA: MISCELANEOS

ENCUESTADOR LEA: "PENSANDO EN LOS HABITOS DE CONSUMO DE PRODUCTOS MISCELANEOS EN LOS ÚLTIMOS 12 MESES FAVOR RESPONDA LAS SIGUIENTES PREGUNTAS"

ENCUESTADOR LEA "AHORA VAMOS A PASAR A ALIMENTOS QUE TIENEN BASTANTE SAL"

A. ¿Con qué frecuencia usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA ESCALA Y ENTREGUE TARJETA NO. 1) – RESPUESTA ÚNICA)
B. Cada vez que consume ___ __(REEEMPLACE POR PORCION Y ALIMENTO)? ¿Cuánto consume? (ESPONTÁNEA – REGISTRE DATO EXACTO SUMINISTRADO POR EL ENCUESTADO)
C. ¿ Donde usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
D. ¿En qué momento del día consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES Y ENTREGUE TARJETA NO. 2) RESPUESTA ÚNICA

				A. Consumo promedio durante el año anterior									B. Cantidad	C. Lugar de consumo		D. Lo consume más frecuentemente al:				
						Veces por semana			Veces al día											
Ítem	Alimento	Porción	Tamaño porción	Nunca o casi nunca	1 a 3 veces / mes	1	2-4	5-6	1	2-3	4-6	Más de 6		En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cena
119	Sopas y cremas de sobre	1 plato		0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
120	Mostaza	1 Cucharadita		0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
121	Mayonesa comercial	1 cucharada	15g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
122	Salsa de tomate	1 cucharada	15 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
ENC: PIENSE EN LAS PREPARACIONES EN LAS CUALES SE ADICIONA SAL EJ: ARROZ, ENSALDAS, HUEVOS, CARNE, POLLO ETC																				
123	Sal	1 pizca/sobre	1g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CATEGORIA: BEBIDAS

ENCUESTADOR LEA: "PENSANDO EN LOS HABITOS DE CONSUMO DE BEBIDAS EN LOS ULTIMOS 12 MESES POR FAVOR RESPONDA LAS SIGUIENTES PREGUNTAS"

A. ¿Con qué frecuencia usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA ESCALA Y ENTREGUE TARJETA NO. 1) – RESPUESTA ÚNICA)

B. Cada vez que consume ___ __(REEEMPLACE POR PORCION Y ALIMENTO)? ¿Cuánto consume? (ESPONTÁNEA – REGISTRE DATO EXACTO SUMINISTRADO POR EL ENCUESTADO)

C. ¿ Donde usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)

D. ¿En qué momento del día consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES Y ENTREGUE TARJETA NO. 2) RESPUESTA ÚNICA

				A. Consumo promedio durante el año anterior									B. Cantidad	C. Lugar de consumo		D. Lo consume más frecuentemente al:				
						Veces por semana			Veces al día											
Ítem	Alimento	Porción	Tamaño porción	Nunca o casi nunca	1 a 3 veces / mes	1	2-4	5-6	1	2-3	4-6	Más de 6		En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cena
124	Gaseosa normal	1 botella	360 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
125	Gaseosa baja en Calorías (light, zero, ligera, Diet)	1 botella	360 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
126	Agua de fruta o Sabor	1 vaso	250 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
127	Aguadepanela	1 tasa	250 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
128	Jugos de fruta hechos en casa	1 vaso	250 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
129	Jugos de fruta o té en caja o botella (industrializados)	1 vaso	250 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
130	Café negro	1 pocillo tintero	100 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
131	Chocolate en agua	1 pocillo	250 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
132	Malta	1 unidad	330 ml	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
133	Bebidas Energizantes (RedBull, Vive100, PeaK, Monster, Speed Max, Predator X, Energy)	1 unidad	240ml	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
134	Bebidas Hidratantes (Gatorade, Powerade, Squash, Activade)	1 unidad	500 ml	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
135	Vino tinto	1 vaso	120 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
136	Vino blanco	1 vaso	120 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
137	Cerveza	1 botella	350 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
138	Licores (amaretto o licor de café)	1 copa	45 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
139	Destilados (Aguardiente, ron, wisky, vodka, ginebra)	1 copa	45 mL	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CATEGORIA: SUPLEMENTOS

A1. ¿En los últimos 12 meses usted ha consumido suplementos nutricionales? **(MOSTRAR TARJETA SUPLEMENTOS)**
ENC LEA: "NO INCLUYE PREPARACIONES CASERAS- HECHAS EN CASA- LA PREGUNTA INDAGA POR PRODUCTOS COMERCIALES"

Si____1 CONTINUE PREGUNTANDO CUALES No_____2 PASE A ALIMENTOS AUTOCTONOS DE LA CIUDAD RESPECTIVA

A. ¿Con qué frecuencia usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA ESCALA Y ENTREGUE TARJETA NO. 1) – RESPUESTA ÚNICA)
B. Cada vez que consume ___ __(REEEMPLACE POR PORCION Y ALIMENTO)? ¿Cuánto consume? (ESPONTÁNEA – REGISTRE DATO EXACTO SUMINISTRADO POR EL ENCUESTADO)
C. ¿ Donde usted consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
D. ¿En qué momento del día consume __(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES Y ENTREGUE TARJETA NO. 2) RESPUESTA ÚNICA

				A. Consumo promedio durante el año anterior								B. Cantidad	C. Lugar de consumo		D. Lo consume más frecuentemente al:				
						Veces por semana			Veces al día										
Ítem	Alimento	Porción	Tamaño porción	Nunca o casi nunca	1 a 3 veces / mes	1	2-4	5-6	1	2-3	4-6	Más de 6		En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cen
140	¿Cuál?			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
141	¿Cuál?			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
142	¿Cuál?			0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CATEGORIA: ALIMENTOS AUTÓCTONOS BOGOTÁ

(Sólo aplica para entrevistados de esta ciudad)

Ítem	Alimento	Porción	Tamaño porción	A. Consumo promedio durante el año anterior									B. Cantidad	C. Lugar de consumo :		D. Lo consume más frecuentemente al:				
				Nunca o casi nunca	1 a 3 veces / mes	Veces por semana			Veces al día					En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cen
						1	2-4	5-6	1	2-3	4-6	Más de 6								
143	Ajiaco santafereño	1 plato	300 ml	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
144	Tamal	1 unidad	400gr	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
145	Envuelto de Maíz	1 unidad mediana	120 gr	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CATEGORIA: ALIMENTOS AUTÓCTONOS MEDELLIN

(Sólo aplica para entrevistados de esta ciudad)

Ítem	Alimento	Porción	Tamaño porción	A. Consumo promedio durante el año anterior									B. Cantidad	C. Lugar de consumo		D. Lo consume más frecuentemente al:				
				Nunca o casi nunca	1 a 3 veces / mes	Veces por semana			Veces al día					En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cen
						1	2-4	5-6	1	2-3	4-6	Más de 6								
146	Mazamorra antioqueña	1 plato	300 ml	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
147	Arepa de choclo	1 unidad	75 gr	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
148	Tamales paisas	1 unidad	400gr	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CATEGORIA: ALIMENTOS AUTÓCTONOS CALI
(Sólo aplica para entrevistados de esta ciudad)

Ítem	Alimento	Porción	Tamaño porción	A. Consumo promedio durante el año anterior									B. Cantidad	C. Lugar de consumo		D. Lo consume más frecuentemente al:				
				Nunca o casi nunca	1 a 3 veces / mes	Veces por semana			Veces al día					En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cen
						1	2-4	5-6	1	2-3	4-6	Más de 6								
149	Sancocho valluno de gallina	1 Plato	300 ml	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
150	Champús	1 vaso 300ml		0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
151	Arroz atollado		150 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CATEGORIA: ALIMENTOS AUTÓCTONOS BUCARAMANGA
(Sólo aplica para entrevistados de esta ciudad)

Ítem	Alimento	Porción	Tamaño porción	A. Consumo promedio durante el año anterior									B. Cantidad	C. Lugar de consumo :		D. Lo consume más frecuentemente al:				
				Nunca o casi nunca	1 a 3 veces / mes	Veces por semana			Veces al día					En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cen
						1	2-4	5-6	1	2-3	4-6	Más de 6								
152	Chivo o Cabro	1 ración pequeña	120 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
153	Tamal de maíz con guiso-Hallacas	1 unidad	250g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
154	Sopa de mute santandereano	1 taza	250 ml	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CATEGORIA: ALIMENTOS AUTÓCTONOS BARRANQUILLA

(Sólo aplica para entrevistados de esta ciudad)

Ítem	Alimento	Porción	Tamaño porción	A. Consumo promedio durante el año anterior									B. Cantidad	C. Lugar de consumo		D. Lo consume más frecuentemente al:				
				Nunca o casi nunca	1 a 3 veces / mes	Veces por semana			Veces al día					En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cen
						1	2-4	5-6	1	2-3	4-6	Más de 6								
155	Suero costeño	1cuchara	15 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
156	Arepa de huevo	1unidad	80 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
157	Carimañola	1 unidad	60g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

PREGUNTAS CONTROL

PROGRAMADOR: ESTAS DEBEN SER INSERTADAS ALEATORIAMENTE ENTRE LOS ITEMS ALIMENTICIOS Y NO DEBEN TENER CONSISTENCIA CON LA RESPUESTA INICIAL

Pregunta control 1 (chequea respuesta al ítem 92)

Pregunta control 2 (chequea respuesta al ítem 52)

Ítem	Alimento	Porción	Tamaño porción	A. Consumo promedio durante el año anterior									B. Cantidad	C. Lugar de consumo		C. Lo consume más frecuentemente al:				
				Nunca o casi nunca	1 a 3 veces / mes	Veces por semana			Veces al día					En casa	Fuera de casa	Desayuno	Media mañana	Almuerzo	Media tarde	Cen
						1	2-4	5-6	1	2-3	4-6	Más de 6								
89	Frutos secos (maní, almendra o nueces)	1/2 pocillo tintero	50 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5
50	Galletas de sal (Saltín, dux, club social)	1 paquete Individual	25 g	0	1	2	3	4	5	6	7	8	/__/__/	1	2	1	2	3	4	5

CONTINUE CON FORMULARIO NO.2 ACTIVIDAD FISICA

Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018	*Centro Nacional de Consultoría Ltda.* *Calle 82 No. 6- 51* *Teléfono: 339 4888*	FORMATO SELECCIÓN HOMBRES
Centro de Costos:4098_01	Fecha: 3 de septiembre de 2018 Versión Final	Prueba piloto : SI
Elaborado por: Alejandra Campuzano	Revisado por: María Cecilia Alfonso Jovinton Yaya	Revisado en Campo por: Gladys Muñoz

Saludo al Informante. Muy buenos días/ tardes/ noches (Nombre del informante). Mi nombre es (nombre y apellido) del **Centro Nacional de Consultoría**, una empresa privada dedicada a la investigación de mercados, social y de opinión pública. Actualmente adelantamos un estudio para evaluar el consumo de alimentos en residentes de cinco ciudades del país, además de conocer el estado nutricional y posible riesgo de diabetes.

Su participación es voluntaria y en atención a la ley sobre tratamiento de datos personales, su identidad y sus respuestas son de carácter confidencial y se utilizarán únicamente con fines estadísticos, como lo establece nuestra política de datos.

Para hacerlo requerimos información de personas de 2 a 75 años. ¿En este hogar hay personas con esta descripción?

ENCUESTADOR: Diligencie los datos de ubicación de la vivienda dónde aplicará el filtro de la Tabla de selección de Kish.

ID- CARTOGRAFIA	Sector	Sección	Manzana	CABEZOTE ENCUESTA
____ ____ ____	____ ____ ____ ____	____ ____	____ ____	
Dirección de la Vivienda dónde aplicará filtro: _____ Barrio de la Vivienda dónde aplicará filtro: _____				

¿Podría decirme de mayor a menor los nombres y las edades de las MUJERES que conforman este hogar entre 2 y 75 años? **(E: SÓLO INCLUYA LAS PERSONAS QUE CONFORMAN EL HOGAR, PERSONAS QUE VIVAN PERMANENTEMENTE EN EL HOGAR Y COMPARTAN LOS ALIMENTOS-** RESIDENTE HABITUAL: PERSONA QUE VIVE PERMANENTEMENTE O LA MAYOR PARTE DEL TIEMPO EN UNA VIVIENDA, AUNQUE EN EL MOMENTO DE LA ENCUESTA SE ENCUENTRE AUSENTE)

NO INCLUYA EMPLEADOS, EXTRANJEROS RESIDENTES QUE LLEVEN MENOS DE 1 AÑO VIVIENDO EN COLOMBIA, PERSONAS EN CONDICIÓN ESPECIAL DE ALIMENTACIÓN (DIÁLISIS, TRASFUSIONES DE SANGRE, ALIMENTACIÓN ENTERAL-SONDA, HOSPITALIZACIÓN RECIENTE, CONSUMO DE DROGAS ALUCINÓGENAS Y PERSONAS CON DISCAPACIDADES (FISICAS O COGNITIVAS) QUE LES IMPIDAN RESPONDER LA ENCUESTA APROPIADAMENTE, PERSONAS INSTITUCIONALIZADAS (PROGRAMAS ICBF O BIENESTAR SOCIAL).

ENCUESTADOR RECUERDE: NO CONSTITUYEN CRITERIO DE EXCLUSIÓN:EMBARAZO, LACTANCIA, USO DE SUPLEMENTOS DIETARIOS O ALIMENTOS FORTIFICADOS, SER DEPORTISTA DE ALTO RENDIMIENTO, ALIMENTACIÓN CONDICIONADA POR FACTORES RELIGIOSOS, DIETA VEGETARIANA, VEGANA O RESTRINGIDA EN ALGÚN ALIMENTO POR ALERGIA O INTOLERANCIA, DIETA LÍQUIDA PRE O POSQUIRÚRGICA.

N° DE ORDEN *(CIRCULE EL SELECCIONADO)	NOMBRE Y APELLIDO	FECHA DE CUMPLEAÑOS Día/Mes/ Año	EDAD
01			
02			
03			
04			
05			
06			
07			
08			
09			

*E: De acuerdo a la tabla anterior, seleccione la persona que cumplió años más recientemente a la fecha de la aplicación de la encuesta.

	Fecha	Hora	Resultado de la visita
Visita 1			
Visita 2			
Visita 3			

5. SÍ ES NECESARIO HACER REMPLAZO DILIGENCIE LA TABLA DE CONTACTOS NO EFECTIVOS) ¿CUÁL FUE EL MOTIVO DEL REEMPLAZO?

Nadie en la casa (hogar)	**01** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
No hay personas entre 2-75 años en el hogar	**02** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Rechazo del hogar /persona si atiende pero no colabora	**03** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Rechazo del portero/no permitió el ingreso	**04** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Edificación no residencial (Comercio, industria, bodega)	**05** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Persona incapacitada Física o psicológicamente) para responder	**06** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Persona seleccionada no se encuentra en 2 visitas	**07** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Persona seleccionada se negó a participar	**08** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Abandono de entrevista	**09** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Persona sorteada accede a participar	**10** Encuesta Efectiva

ENCUESTADOR: UNA VEZ TENGA A LA PERSONA SELECCIONADA CONTINUE CON EL SALUDO INICIAL.

Saludo al Informante. Muy buenos días/ tardes/ noches (Nombre del informante). Mi nombre es (nombre y apellido) del **Centro Nacional de Consultoría**, una empresa privada dedicada a la investigación de mercados, social y de opinión pública. Actualmente estamos realizando el **Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018** cuyo objetivo es estimar la ingesta habitual de alimentos y nutrientes en residentes de las cinco principales ciudades de Colombia: Bogotá, Cali, Medellín, Barranquilla y Bucaramanga y estudiar cómo se asocia con el manejo de los azucares por el cuerpo.

Su participación es voluntaria y en atención a la ley sobre tratamiento de datos personales, su identidad y sus respuestas son de carácter confidencial y se utilizarán únicamente con fines estadísticos, como lo establece nuestra política de datos.

Le agradecemos nos dedique que me dedique **60 minutos**

Para cualquier inquietud puede comunicarse con el Centro Nacional de Consultoría, teléfono 3394888 en Bogotá, 6046721 en Medellín, 6674600 en Cali, 6457483 en Bucaramanga ó 3585695 en Barranquilla.

DATOS DEL SELECCIONADO	
Nombre completo el entrevistado:	
Dirección :	Teléfono de contacto:
Fecha de nacimiento: (dd/mm/aaaa)	Edad:

DATOS DEL CIUDADOR – DEL RESPONSABLE DEL MENOR DE 13 AÑOS	
Nombre completo del cuidador:	
Parentesco con el menor	Teléfono de contacto:

Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018	*Centro Nacional de Consultoría Ltda.* *Calle 82 No. 6- 51* *Teléfono: 339 4888*	FORMATO SELECCIÓN MUJERES
Centro de Costos:4098_01	Fecha: 3 de septiembre de 2018 Versión final	Prueba piloto : SI
Elaborado por: Alejandra Campuzano	Revisado por: María Cecilia Alfonso Jovinton Yaya	Revisado en Campo por: Gladys Muñoz

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Para hacerlo requerimos información de personas de 2 a 75 años. ¿En este hogar hay personas con esta descripción?

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ID- CARTOGRAFIA	Sector	Sección	Manzana	CABEZOTE ENCUESTA
____ ____ ____	____ ____ ____ ____	____ ____	____ ____	
Dirección de la Vivienda dónde aplicará filtro: _____ Barrio de la Vivienda dónde aplicará filtro: _____				

¿Podría decirme de mayor a menor los nombres y las edades de las MUJERES que conforman este hogar entre 2 y 75 años? **(E: SÓLO INCLUYA LAS PERSONAS QUE CONFORMAN EL HOGAR, PERSONAS QUE VIVAN PERMANENTEMENTE EN EL HOGAR Y COMPARTAN LOS ALIMENTOS** RESIDENTE HABITUAL: PERSONA QUE VIVE PERMANENTEMENTE O LA MAYOR PARTE DEL TIEMPO EN UNA VIVIENDA, AUNQUE EN EL MOMENTO DE LA ENCUESTA SE ENCUENTRE AUSENTE)

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ENCUESTADOR RECUERDE: NO CONSTITUYEN CRITERIO DE EXCLUSIÓN:EMBARAZO, LACTANCIA, USO DE SUPLEMENTOS DIETARIOS O ALIMENTOS FORTIFICADOS, SER DEPORTISTA DE ALTO RENDIMIENTO, ALIMENTACIÓN CONDICIONADA POR FACTORES RELIGIOSOS, DIETA VEGETARIANA, VEGANA O RESTRINGIDA EN ALGÚN ALIMENTO POR ALERGIA O INTOLERANCIA, DIETA LÍQUIDA PRE O POSQUIRÚRGICA.

N° DE ORDEN *(CIRCULE EL SELECCIONADO)	NOMBRE Y APELLIDO	FECHA DE CUMPLEAÑOS Día/Mes/ Año	EDAD
01			
02			
03			
04			
05			
06			
07			
08			
09			

*E: De acuerdo a la tabla anterior, seleccione la persona que cumplió años más recientemente a la fecha de la aplicación de la encuesta.

	Fecha	Hora	Resultado de la visita
Visita 1			
Visita 2			
Visita 3			

5. SÍ ES NECESARIO HACER REMPLAZO DILIGENCIE LA TABLA DE CONTACTOS NO EFECTIVOS) ¿CUÁL FUE EL MOTIVO DEL REEMPLAZO?

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No hay personas entre 2-75 años en el hogar	**02** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Rechazo del hogar /persona si atiende pero no colabora	**03** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Rechazo del portero/no permitió el ingreso	**04** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Edificación no residencial (Comercio, industria, bodega)	**05** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Persona incapacitada Física o psicológicamente) para responder	**06** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Persona seleccionada no se encuentra en 2 visitas	**07** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Persona seleccionada se negó a participar	**08** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Abandono de entrevista	**09** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Persona sorteada accede a participar	**10** Encuesta Efectiva

ENCUESTADOR: UNA VEZ TENGA A LA PERSONA SELECCIONADA CONTINUE CON EL SALUDO INICIAL.

Saludo al Informante. Muy buenos días/ tardes/ noches (Nombre del informante). Mi nombre es (nombre y apellido) del **Centro Nacional de Consultoría**, una empresa privada dedicada a la investigación de mercados, social y de opinión pública. Actualmente adelantamos un estudio para evaluar el consumo de alimentos en residentes de cinco ciudades del país, además de conocer el estado nutricional y posible riesgo de diabetes.

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Le agradecemos nos dedique que me dedique **60 minutos**

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DATOS DEL SELECCIONADO	
Nombre completo el entrevistado:	
Dirección :	Teléfono de contacto:
Fecha de nacimiento: (dd/mm/aaaa)	Edad:

DATOS DEL CIUDADOR – DEL RESPONSABLE DEL MENOR DE 13 AÑOS	
Nombre completo del cuidador:	
Parentesco con el menor	Teléfono de contacto:

Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018	*Centro Nacional de Consultoría Ltda.* *Calle 82 No. 6- 51* *Teléfono: 339 4888*	FORMULARIO No.2 ACTIVIDAD FISICA -Mayores de 14 años-
Centro de Costos: 4098_01	Fecha: 3 de septiembre de 2018 Versión Final	Prueba piloto : SI
Elaborado por: Dr. Carlos O Mendivil Profesor Asociado Angélica Montaño, ND, Esp UNIVERSIDAD DE LOS ANDES	Revisado por: Alejandra Campuzano CENTRO NACIONAL DE CONSULTORÍA Eddy Carolina Betancourt TEAM	Revisado en Campo por: Gladys Muñoz CENTRO NACIONAL DE CONSULTORÍA

ENCUESTADOR LEA: AHORA PENSANDO EN LA ACTIVIDAD FISICA DE LOS ULTIMOS 7 DIAS, POR FAVOR RESPONDA LAS SIGUIENTES PREGUNTAS

1. Pensando en los últimos 7 días ¿En cuántos días realizó actividades físicas intensas tales como levantar pesos pesados, cavar, hacer ejercicios aeróbicos o andar rápido en bicicleta?

/___/____/ (NÚMERO NO PUEDE SER MAYOR A 7 DIAS) **CONTINUE**
No realizó en los últimos 7 días ninguna actividad física intensa ____9 **PASE A P.3**

2. ¿Cuánto tiempo en total dedicó a una actividad física intensa en UNO DE ESOS DIAS? **(ESPONTÁNEA - RESPUESTA ÚNICA)**

Horas al día	1	_____
Minutos al día	2	_____
No sabe/ no está seguro	9	

3. Pensando en los últimos 7 días, ¿en cuántos días realizó actividades físicas moderadas tales como transportar pesos livianos, o andar en bicicleta a velocidad regular? **NO INCLUYA CAMINAR**

/___/____/ (NÚMERO NO PUEDE SER MAYOR A 7 DIAS) **CONTINUE**
No realizó en los últimos 7 días ninguna actividad física moderada ____9 **PASE A P.5**

4. ¿Cuánto tiempo en total dedicó a una actividad física moderada en UNO DE ESOS DIAS? **(ESPONTÁNEA - RESPUESTA ÚNICA)**

Horas al día	1	_____
Minutos al día	2	_____
No sabe/ no está seguro	9	

5. Pensando en los últimos 7 días, ¿en cuántos días caminó por lo menos 10 minutos seguidos?

/___/____/ (NÚMERO NO PUEDE SER MAYOR A 7 DIAS) **CONTINUE**
No caminó en los últimos 7 días ____9 **PASE A P.7**

6. ¿Cuánto tiempo en total dedicó a caminar en UNO DE ESOS DIAS ? **(ESPONTÁNEA - RESPUESTA ÚNICA)**

Horas al día	1	____/____
Minutos al día	2	____/____
No sabe/ no está seguro	9	

7. Pensando en los últimos 7 días, ¿cuánto tiempo pasó sentado durante UN DIA HABIL TIPICO?

Horas al día	1	_____
Minutos al día	2	_____
No sabe/ no está seguro	9	

CONTINUE CON FORMULARIO NO.3 MEDIDAS ANTROPOMÉTRICAS

Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018	*Centro Nacional de Consultoría Ltda.* *Calle 82 No. 6- 51* *Teléfono: 339 4888*	FORMULARIO NO.3 MEDIDAS ANTROPOMETRICAS
Centro de Costos: 4098_01	Fecha: 3 de septiembre de 2018 Versión Final	Prueba piloto : SI
Elaborado por: Dr. Carlos O Mendivil Profesor Asociado Angélica Montaño, ND, Esp UNIVERSIDAD DE LOS ANDES	**Revisado por:** Alejandra Campuzano CENTRO NACIONAL DE CONSULTORÍA Eddy Carolina Betancourt V TEAM	**Revisado en Campo por:** Gladys Muñoz CENTRO NACIONAL DE CONSULTORÍA

E: COLOQUE LOS DISPOSITIVOS DE PESO Y TALLA SEGÚN LAS INDICACIONES DEL INSTRUCTIVO Y TOME LAS MEDIDAS SEGÚN LAS INDICACIONES

ENCUESTADOR LEA: AHORA INICIAREMOS LA TOMA DE MEDIDAS ANTROPOMETRICAS (TALLA, PESO Y CIRCUNFETRENCIA DE CINTURA)

ESTADIÓMETRO- TALLA		
Talla	**Resultado**	**Condición**
1. Talla (cm) –primera medida-	□□□.□	ENC: EN CASO DE MEDIR MENOS DE 100 CM, EN EL PRIMER ENTERO SE DEBE INCLUIR UN CERO
2. Talla (cm) –segunda medida-	□□□.□	
3. Talla (cm) –tercera medida-	□□□.□	Realizar medida 3 en caso que |T1-T2|>0.5 cm

BALANZA- PESO		
Medida	**Resultado**	**Condición**
1. Peso (Kg) –primera medida-	□□□.□	ENC: EN CASO DE PESAR MENOS DE 100 KG, EN EL PRIMER ENTERO SE DEBE INCLUIR UN CERO
2. Peso (Kg) –segunda medida-	□□□.□	
3. Peso (Kg) –tercera medida-	□□□.□	Realizar Medida 3 en caso que |M1 –M2 | >100 gramos kg

ENC: ESTA MEDICIÓN NO SE TOMA A MUJERES GESTANTES NI MENORES DE 18 AÑOS

CINTA MÉTRICA- CIRCUNFERENCIA DE CINTURA		
Talla	**Resultado**	**Condición**
1. Cintura(cm) –primera medida-	□□□.□	ENC: EN CASO DE P MEDIR MENOS DE 100 CM, EN EL PRIMER ENTERO SE DEBE INCLUIR UN CERO
2. Cintura(cm) –segunda medida-	□□□.□	
3. Cintura(cm) –tercera medida-	□□□.□	Realizar medida en caso que la diferencia entre |C1-C2| sea menor o igual a 1cm

REHUSA TOMA DE MEDIDA DE CIRCUNFRENCIA _____9

CONTINUE CON FORMULARIO NO.4 GLUCOMETRIA Y MUESTRA CAPILAR

Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018	*Centro Nacional de Consultoría Ltda.* *Calle 82 No. 6- 51* *Teléfono: 339 4888*	FORMULARIO No. 4 GLUCOMETRIA Y MUESTRA CAPILAR -Mayores de 18 años-
Centro de Costos: 4098_01	Fecha: 3 de septiembre de 2018	Prueba piloto : SI
Elaborado por: Dr. Carlos O Mendivil Profesor Asociado Angélica Montaño, ND, Esp UNIVERSIDAD DE LOS ANDES	Revisado por: Alejandra Campuzano CENTRO NACIONAL DE CONSULTORÍA Eddy Carolina Betancourt V TEAM	Revisado en Campo por: Gladys Muñoz CENTRO NACIONAL DE CONSULTORÍA

SI EL INFORMANTE ES MENOR DE 18 AÑOS PASE A AGRADECIMIENTOS

ENC: ¿EL INFORMANTE ACEPTÓ LA GLUCOMETRIA Y MUESTRA CAPILAR?

Sí	1	CONTINUE	No	2	PASE A AGRADECIMIENTOS

ENFERMERA: ORGANICE TODOS LOS ELEMENTOS PARA LA TOMA DE GLUCOMETRIA Y MUESTRA CAPILAR SEGÚN LAS INDICACIONES DEL INSTRUCTIVO

ENCUESTADOR: DILIGENCIE LOS DATOS QUE INDIQUE LA ENFEREMERA Y CONFIRME CADA DATO DOS VECES

RESULTADO GLUCOMETRIA	□□□
NUMERO DE INDENTIFICACIÓN DE TUBO DE MUESTRA CAPILAR (Numeración Asignada por la Universidad de los Andes)	□□□□

ENCUESTADOR: ANTES DE HACER EL CIERRE DE LA ENCUESTA JUNTO CON LA ENFEREMERA DILIGENCIE EL FORMATO DE CONTROL DE MUESTRAS CAPILARES

AGRADECIMIENTOS

Nuevamente quiero agradecerle su colaboración en nombre del Centro Nacional de Consultoría. Finalmente, quisiera preguntarle

1. ¿Estaría dispuesto en el futuro a volver a colaborar con nosotros?

Sí	1	No	2

2. ¿Nos permitiría compartir la información suministrada y datos de contacto en la presente con nuestros aliados en la investigación Universidad de los Andes y TEAM?

Sí	1	No	2

CONTROLES FINALES							
Fecha de la encuesta Día /____/____/ Mes /____/____/ Año /2018/				**Hora inicio** /____/____/: /____/____/ **Fin** /____/____/: /____/____/			
Encuestador Cédula				Supervisor Cédula			
SUPERVISIÓN		**HALLAZGO**	**RESPONSABLE**	**ACCIÓN**	**RESPONSABLE**	**APROB**	**RECHAZO**
Monitorización (75%)	1					1	2
Re-contacto Presencial	2					1	2
Re-contacto Telefónico	3					1	2
Revisión en Campo	4					1	2
Revisión en Crítica	5					1	2
Notas							
HALLAZGO: 1 Inconsistencia- 2 Datos Ficticios- 3 Pregunta faltante **ACCIÓN:** 5 Anular- 6 Verificar- 7 Recuperar- 8 Devolver a Campo **APROBADO/RECHAZADO**						Verificad	Codificad
Verificación de Crítica	6	**HALLAZGO**		**ACCIÓN**			
HALLAZGO: 1 Omisión código - 2 Código errado - 3 Omisión de crítica				**ACCIÓN**: 1 Asignar código - 2 Corregir - 3 Revisión pases/Revisión campos - 7 Otro			

TARJETA No. 1

PFRECUENCIA DE CONSUMO	
Nunca o casi nunca	
1 a 3 veces / mes	
Veces por semana	1
	2-4
	5-6
Veces al día	1
	2-3
	4-6
	Mas de 6

LUGAR DE CONSUMO
En Casa
Fuera de casa (Restaurante, cafetería, hotel, tienda, centro comercial)

MOMENTO DEL DIA
Desayuno
Media mañana
Almuerzo
Media tarde
Cena

TARJETA PORCIONES

-Medidas caseras-

Imagen	Imagen	Imagen
1 CUCHARITA ≈7g	**1 CUCHARA SOPERA ≈15g**	**1 CUCHARARÓN MEDIANO ≈100g**

TARJETA PORCIONES

-Volumen-

Imagen	Imagen	Imagen
POCILLO TINTERO (80 ML)	**POCILLO MEDIANO (150 ML)**	**POCILLO GRANDE O MUG (300 ML)**

TARJETA PORCIONES

-Volumen-

1

Imagen

2

Imagen

3

Imagen

4

Imagen

1. **VASO MINI 5 OZ. (150 ML)**
2. **VASO PEQUEÑO 7 OZ. (200 ML)**
3. **VASO MEDIANO 8 OZ. (250 ML)**
4. **VASO GRANDE 10 OZ. (300 ML)**

TARJETA LACTEOS

-Otros alimentos-

YOGURT O KUMIS 200 ml Bebida de leche fermentada con bacterias lácticas (probióticos) activos hasta su consumo final. Su textura es cremosa y puede tener adición de frutas y cereal.	Imagen	**YOGURT GRIEGO 150g** Yogurt descremado de leche de vaca o cabra, doble proteina 1 vaso (150 gramos)	Imagen	**BEBIDA LÁCTEA 150 ml** Bebida de consistencia fluida o líquida, hecha a partir de leche mezclada con derivados lácteos como suero de leche, proteínas lácteas y lactosa.	Imagen
YOX DEFENSIS 100 ml bebida láctea acidificada	Imagen	**ALPINETTE 140g** Postre de leche entera con dulce de frutas	Imagen	**YOGURT CUCHAREABLE 150g** Consistencia firme	Imagen

TARJETA HUEVOS CARNES Y PESCADOS -

Otros alimentos-

Imagen	Imagen	Imagen
HUEVOS DE CODORNIZ **5 unidades (50 g)**	**CARNES: RES, POLLO, CERDO: 1 porción pequeña** (½ palmo = 60 gramos 1/8 de libra)	**CARNES TÍPICAS** Ternera, conejo, chivo, ovejo, cuy, pato, otros pescados de mar o ríos.
Imagen	Imagen	Imagen
OTRAS CARNES DE MONTE: Mamíferos: ponche o chigüiro, guardatinajo, armadillo. Reptiles: iguana, tortuga,. Aves: palomas, torcazas y otros. Insectos: hormigas.	**OTROS EMBUTIDOS: Butifarra, génovas, longaniza.**	**PREPARACIONES: Pepitoria**

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TARJETA LEGUMINOSAS Y HARINAS

-Otros alimentos-

Imagen	Imagen	Imagen
Arepa de maíz pelado santandereano 100 gr	**Arepa boyacense 100 gr**	**Arepa de maíz peto blanco con queso 100 gr**
Imagen	Imagen	Imagen
Pancakes 100 gr	**Arepuela de harina de trigo (torrejas) 60 gr**	**Muffin 60 gr**

TARJETA CEREALES Y LEGUMINOSAS

-alimentos vegetarianos-

Imagen	Imagen	Imagen
Proteína vegetal: soya, lenteja, garbanzo, quinua, Orellana) Carne de soya, hamburguesas, chorizos, salami, salchichas, carne de origen vegetal 100 gramos	**Tofu: queso de soya (30 gramos)**	**Pastas veganas: maíz, arroz, lentejas, quinua, chía. 60 gramos**
Imagen	Imagen	Imagen
Semillas de amaranto, auyama, girasol, calabaza, chía, linaza, quinua, pino (30 gramos)	**Cereales Quinua y amaranto expandidas, arroz integral, arroz salvaje. Arepas de arroz, arepas de almendras y nueces. 30 gramos**	**Leches vegetales (almendras, soya, arroz) 1 vaso 200 ml**

TARJETA FRUTAS

-Otros alimentos-

Imagen	Imagen	Imagen	Imagen
DURAZNO 1 UNIDAD 80 GRAMOS	**FEIJOA 2 UNIDADES 100 GR**	**PITAHAYA 1 UNIDAD MEDIANA 110 GR**	**KIWI 1 UNIDAD 80 GRAMOS**
Imagen	Imagen	Imagen	Imagen
CIRUELA COMÚN 1 UNIDADE 60 GR	**UCHUVA 70 GR 7 UNIDADES**	**MAMONCILLO 10 UNIDADES 50 GRAMOS**	**CHONTADURO 1 UNIDAD 50 GRAMOS**

TARJETA VERDURAS Y HORTALIZAS

-Otros alimentos-

Imagen	Imagen	Imagen	Imagen
ACELGA 1 POCILLO 50 GR	**APIO 1 POCILLO 50 GR**	**TALLOS 1 POCILLO 50 GR**	**GUATILA ¼ UNIDAD 50 GR**
Imagen	Imagen	Imagen	Imagen
RÁBANOS 1 UNIDAD DE 50 GRAMOS	**ESPÁRRAGOS ½ POCILLO 50 GRAMOS**	**CALABAZA 1 TROZO MEDIANO 60 GRAMOS**	**BERENJENA ¼ UNIDAD 50 GRAMOS**

TARJETA ACEITES No.1

Aceite de Oliva	Imágenes
Aceite de Maiz	Imágenes
Aceite de girasol (Girasol en la etiqueta)	Imágenes

TARJETA ACEITES No.2

Aceite de soya	Imágenes
Aceite de Canola	Imágenes
Aceite de palma	Imágenes

TARJETA ACEITES

-Margarinas y mantequillas-

Imágenes	Imágenes	Imágenes	Imágenes
MANTEQUILLA	**MARGARINA DE MESA**	**MARGARINA DE COCINA**	**MANTECA**

TARJETA ACEITES

-Otros alimentos-

Imágenes	Imágenes
COCO RALLADO **2 CUCHARADITA 14 GRAMOS.**	**MANTEQUILLA DE MANÍ O ALMENDRAS 1 CUCHARADITA 10 GRAMOS**

TARJETA DULCES Y POSTRES

-Otros alimentos-

Imágenes	Imágenes	Imágenes
Panela: 1 trozo de 30 gramos, 1 cuchara 15 gr, 1 cucharita 5 gr.	**Miel 1 cuchara 21 gramos**	**Miel de ágave: 1 cuchara 21 gramos**
Imágenes	Imágenes	Imágenes
Jarabe de arce o sirope - Para pancakes	**Fructosa: 1 cucharadita5 gramos**	**Postres: flan, esponjado o mousse, cheesecakes, pie. 1 porción 100 gramos.**

TARJETA BEBIDAS HIDRATANTES

Imágenes	Imágenes
Gatorade	**Activade**
Imágenes	Imágenes
Powerade	**Squash**

Bebida hidratante: destinada fundamentalmente a reponer agua y electrolitos perdidos durante la actividad física y el deporte, calmar la sed, mantener el equilibrio metabólico y suministrar fuentes de energía de fácil absorción y metabolismo rápido.

TARJETA BEBIDAS ENERGIZANTES

Imágenes	Imágenes	Imágenes
RedBull	**Vive100**	**Peak**
Imágenes	Imágenes	
Speed max	**Monster**	

Bebidas energizantes: bebida analcohólica, generalmente gasificadas, compuesta básicamente por cafeína e hidratos de carbono, azúcares diversos de distinta velocidad de absorción, más otros ingredientes, como aminoácidos, vitaminas, minerales, extractos vegetales, acompañados de aditivos acidulantes, conservantes, saborizantes y colorantes.

TARJETA SUPLEMENTOS No1

Suplemento nutricional: producto cuyo propósito es adicionar la dieta normal y que es fuente concentrada de nutrientes y otras sustancias con efecto fisiológico o nutricional que puede contener vitaminas, minerales, proteínas, aminoácidos, otros nutrientes y derivados de nutrientes, plantas, concentrados y extractos de plantas solas o en combinación.

República de Colombia. Decreto 272 de 2009. Decreto 3249 de 2006. Decreto 3863 de 2008.

TARJETA SUPLEMENTOS No.2

EN POLVO PARA RECONSTITUIR Herbalife, Z-Bec, Nut-Rx, Focus-X, Prowhey, Spezante, Nepro,Kola Granulada. - Porción 1 vaso 200 ml-	Imágenes	**MULTIVITAMINAS** Centrum, Herbalife, Diabion, Gestavit, Gestavit DHA, Biosil, Bion3, Pediavit gotas Emulsión de Scott -Porción 1 unidad	Imágenes
LÍQUIDOS Ensure, Pediasure, Glucerna, Enterex - Porción 1 vaso 237 ml-	Imágenes	**PROTEÍNA EN POLVO** Proteinex, Quicker, Megaplex, Testosterol, Proteina H24 ReBuild, Titan Army, Btrust, Lmk BCAA. -Porción 1 cucharada -	Imágenes

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Page 1, line 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found Page 2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Pages 5-7
Objectives	3	State specific objectives, including any prespecified hypotheses Page 7, line 160
Methods		
Study design	4	Present key elements of study design early in the paper Page 7, line 167
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Pages 8-10
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants Page 8, lines 175-185
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Page 9, lines 200-235
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Page 9, lines 200-235
Bias	9	Describe any efforts to address potential sources of bias Page 8, lines 171-179
Study size	10	Explain how the study size was arrived at Page 8, lines 179-181
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Page 9, lines 200-235
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding Page 11, lines 259-283
		(*b*) Describe any methods used to examine subgroups and interactions Page 11, lines 267-272
		(*c*) Explain how missing data were addressed

		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy Page 11, line 259-260
		(*e*) Describe any sensitivity analyses
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Supplemental Figure 1
		(b) Give reasons for non-participation at each stage Supplemental Figure 1
		(c) Consider use of a flow diagram Supplemental Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Table 1, Page 13
		(b) Indicate number of participants with missing data for each variable of interest Not applicable
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures Page 14, lines 309-323
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included Page 14, lines 333-341
		(*b*) Report category boundaries when continuous variables were categorized Page 13, Table 1
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses Page 15, lines 355-369
Discussion		
Key results	18	Summarise key results with reference to study objectives Page 19, lines 409-422
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Page 23, lines 532-546
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Pages 19, 20, 21
Generalisability	21	Discuss the generalisability (external validity) of the study results Page 20, lines 460-473
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based Page 1, line 19